Science and Invention

APRIL
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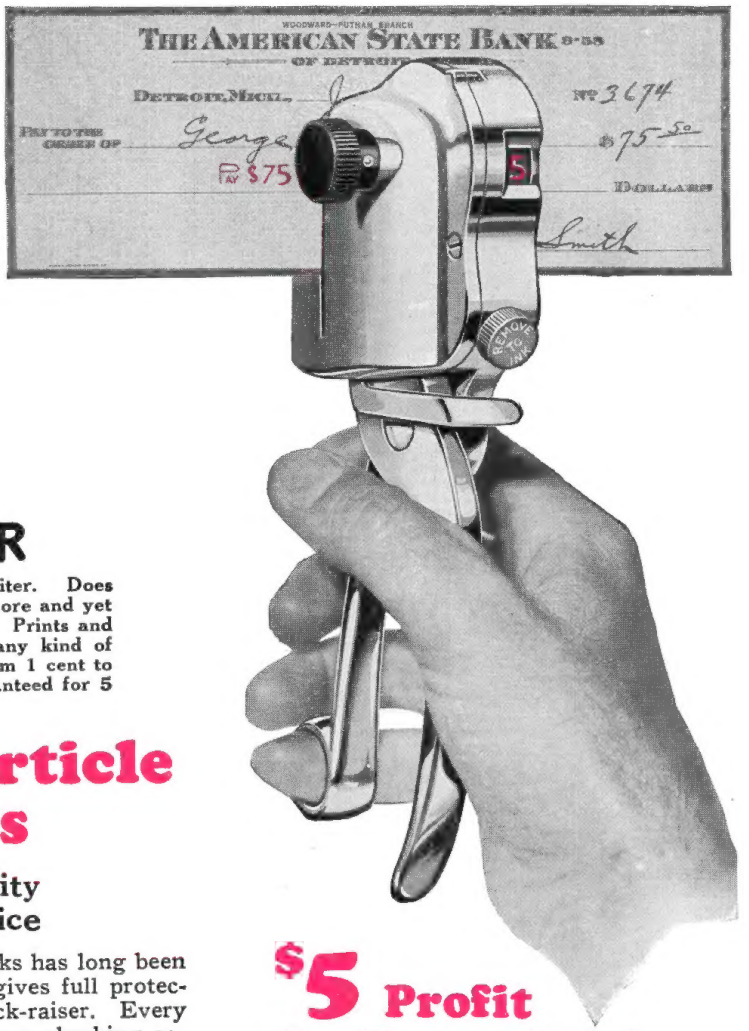
Strongman Tricks Which You Can Do

When the Earth Quakes

Get Into the High-Income Class!

Don't Be Satisfied With Just a Living!

You Can Make As Much As a Bank President



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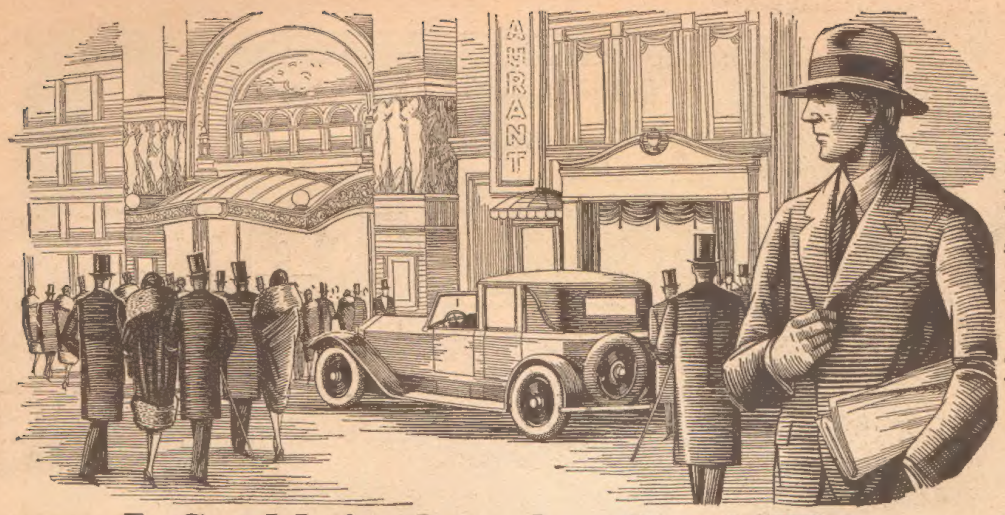
Address .....

City ..... State .....

Arnold Check-Writer Co., Inc.
2615 Industrial Ave. **Flint, Mich.**



Always outside of things —that's where I was just twelve short months ago. I just didn't have the cash, that was all. No theatres, no parties, no good restaurants. No real enjoyment of life. I was just getting by, just existing. What a difference today! I drive my own car, have a good bank account, enjoy all the amusements I please.

I Couldn't Get the Good Things of Life

Then I Quit My Job and "Found" Myself!

HOW does a man go about making more money? If I asked myself that question once, I asked it a hundred times!

I know the answer now—you bet. I know the way good money is made, and I'm making it. Gone forever are the days of cheap shoes, cheap clothes, walking home to save carfare, pinching pennies to make my salary last from one pay-day to the next one. I own one of the finest Radio stores you ever saw, and I get almost all the Radio service and repair work in town. The other Radio dealers send their hard jobs to me, so you can see how I stand in my line.

But—it's just a year ago that I was a poorly paid clerk. I was struggling along on a starvation salary until by accident my eyes were opened and I saw just what was the matter with me. Here's the story of just how it happened.

One of the big moments of my life had come. I had just popped the fatal question, and Louise said, "Yes!"

Louise wanted to go in and tell her father about it right away, so we did. He sort of grunted when we told him the news, and asked Louise to leave us alone. And, my heart began to sink as I looked at his face.

"So you and Louise have decided to get married," he said to me when we were alone. "Well, Bill, just listen to me. I've watched you often here at the house with Louise and I think you are a pretty good, upstanding young fellow. I knew your father and mother, and you've always had a good reputation here, too. But let me ask you just one question—how much do you make?"

"Twenty-eight a week," I told him.

He didn't say a word—just wrote it down on a piece of paper.

"Have you any prospects of a better job or a good raise some time soon?" he asked.

"No, sir; I can't honestly say that I have," I admitted. "I'm looking for something better all the time, though."

"Looking, eh? How do you go about it?"

Well, that question stopped me.

How did I? I was willing to take a better job if I saw the chance all right, but I certainly had laid no plans to make such a job for myself. When he saw my confusion he grunted. "I thought so," he said. Then he held up some figures he'd been scribbling at.

"I've just been figuring out your family budget, Bill, for a salary of twenty-eight a week. I've figured it several ways, so you can take your pick of the one you like best. Here's Budget No. 1: I figure you can afford a very small unfurnished apartment, make your payments on enough plain, inexpensive furniture to fix such an apartment up, pay your electricity, gas and water bills, buy just about one modest outfit of clothes for both of you once each year, and save three dollars a week for sickness, insurance, and emergencies. But you can't eat. And you'll have to go without amusements until you can get a good, substantial raise in salary."

I began to turn red as fire.

"That budget isn't so good after all," he said, glancing at me; "maybe Budget No. 2 will sound better——"

"That's enough, Mr. Sullivan," I said. "Have a heart. I can see things pretty clearly now; things I was kidding myself about before. Let me go home and think this over." And home I went, my mind in a whirl.

At home I turned the problem over and over in my mind. I'd popped the question at Louise on impulse without thinking it out. Everything Mr. Sullivan had said was gospel truth. I couldn't see anything to do, any way to turn. But I had to have more money.

I began to thumb the pages of a magazine which lay on the table beside me. Suddenly an advertisement seemed almost to leap out at my eyes, an advertisement telling of big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the Radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. I read the book carefully, and when I finished it I made my decision.

What's happened in the twelve months since that day seems almost like a dream to me now. For ten of those twelve months I've had a Radio business of my own! At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the institution that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business, such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing, "I never had a chance!"

Now I'm making real money. Louise and I have been married six months, and there wasn't any kidding about budgets by Mr. Sullivan when we stepped off, either. I'll bet that today I make more money than the old boy himself.

Here's a real tip. You may not be as bad off as I was. But, think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years, making the same money? If not, you'd better be doing something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—no matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation—the book is free and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President, National Radio Institute. Dept. 1-DS, Washington, D. C.

J. E. SMITH, President,
National Radio Institute,
Dept. 1-DS, Washington, D. C.

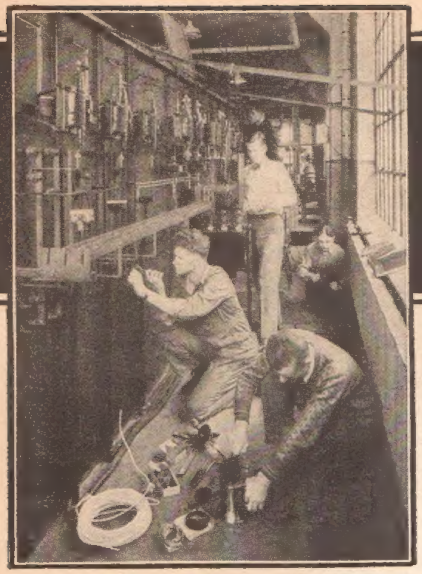
Dear Mr. Smith:

Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesmen will call on me.

Name .....

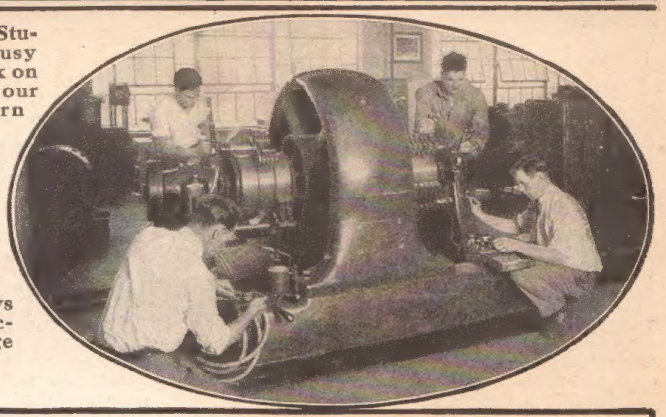
Address .....

Town .....State .....

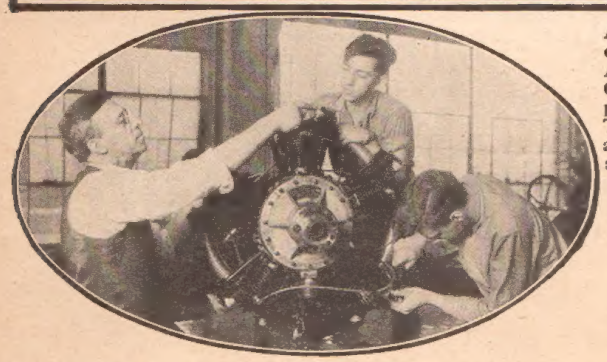


LEARN Without

Coyne Students busy at work on one of our modern A. C. switchboards.

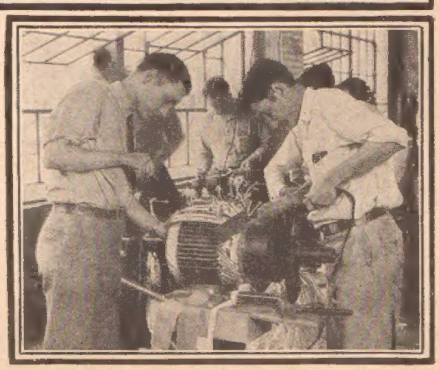


The photo to the right shows several students getting actual experience on a large synchronous converter.



Here you see an Instructor explaining the operation of a modern airplane engine.

A general view of our great Alternating Current Department. These fellows are learning by actual, practical work.



These students are getting actual experience in armature winding and repair.

MAIL COUPON ON OPPOSITE PAGE

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Lessons In 90 Days

By Actual Work In the GREAT COYNE SHOPS

Dissatisfied with your present job? Not making enough money? Then come to Coyne in Chicago and learn Electricity in 90 days—NOT BY CORRESPONDENCE, but by actual electrical work—on huge motors and generators, power plants, substations, switchboards, auto and airplane engines, etc. You don't need advanced education or previous experience. I don't care if you are 16 years old or 46. It makes no difference! **I'll prepare you for a GOOD-PAYING ELECTRICAL JOB in 90 days!**

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MAIL TODAY!

H. C. LEWIS, President
COYNE ELECTRICAL SCHOOL
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Gentlemen: Please send me your Big Electrical Book with 151 illustrations. This does not obligate me.

Name .....

Address .....

City ..... *State* .....

FOR FREE BOOK

APRIL
1931

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HERE is *your* opportunity to acquire the poise and the self-confident bearing that are yours when you KNOW you are using correct English. A new nation-wide Club is being formed and *you* are invited to be one of the first 1,000 Charter Members. The new 15-Minutes-of-English Club shows you how to overcome every weakness in your spoken and written English—quickly, easily—in only 15 minutes a day of your leisure time.

Here is the *true secret of getting ahead!* Every successful man or woman has used this great aid to business and social advancement. More than anything else, your language reveals your true culture and refinement. As the photographic scene at the right shows, even what you may now consider "little" mistakes may be causing others to form a poor opinion of you—may be holding you back from your greatest advancement.

THE 15-Minutes-of-English Club offers you this mastery of correct English and fluent speech through the remarkable five volume CLUB SET. Read in the panel at lower left how this Club Set covers *all* your needs. Whether your "weakness" is in English, in Pronunciation, in Vocabulary, in the ability to write the many forms of Social Letters, or to influence others through effective Speech-Making—the 15-Minute Club plan is ready to help YOU.

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The first volume, MINUTE-A-DAY-ENGLISH, detects and corrects your mistakes in English and then acts as "guide book" to the other volumes. If your weakness is pronunciation, the famous 18,000 WORDS OFTEN MISPRONOUNCED removes this obstacle in the path of your advancement. THE WORD BOOK contains over 100,000 words to build up your vocabulary and help you express your ideas. THE PHRASE BOOK gives you *over* 6,000 *expressions and phrases* for use in conversation, social letter writing, and public speaking. One whole section is devoted to *Social Letter Writing*, telling you how to prepare and answer social letters of all types . . . *Includes over* 100 *model letters.* The fifth volume, READY SPEECH-MAKER, prepares you to grasp your opportunity when you are asked to get up and "say a few words" at a business conference, at a banquet, club or lodge meeting, etc. Gives you *two complete home training methods*—a complete course in public speaking, giving you all that might cost $25 or $50 in "correspondence course" form.

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My Name .....

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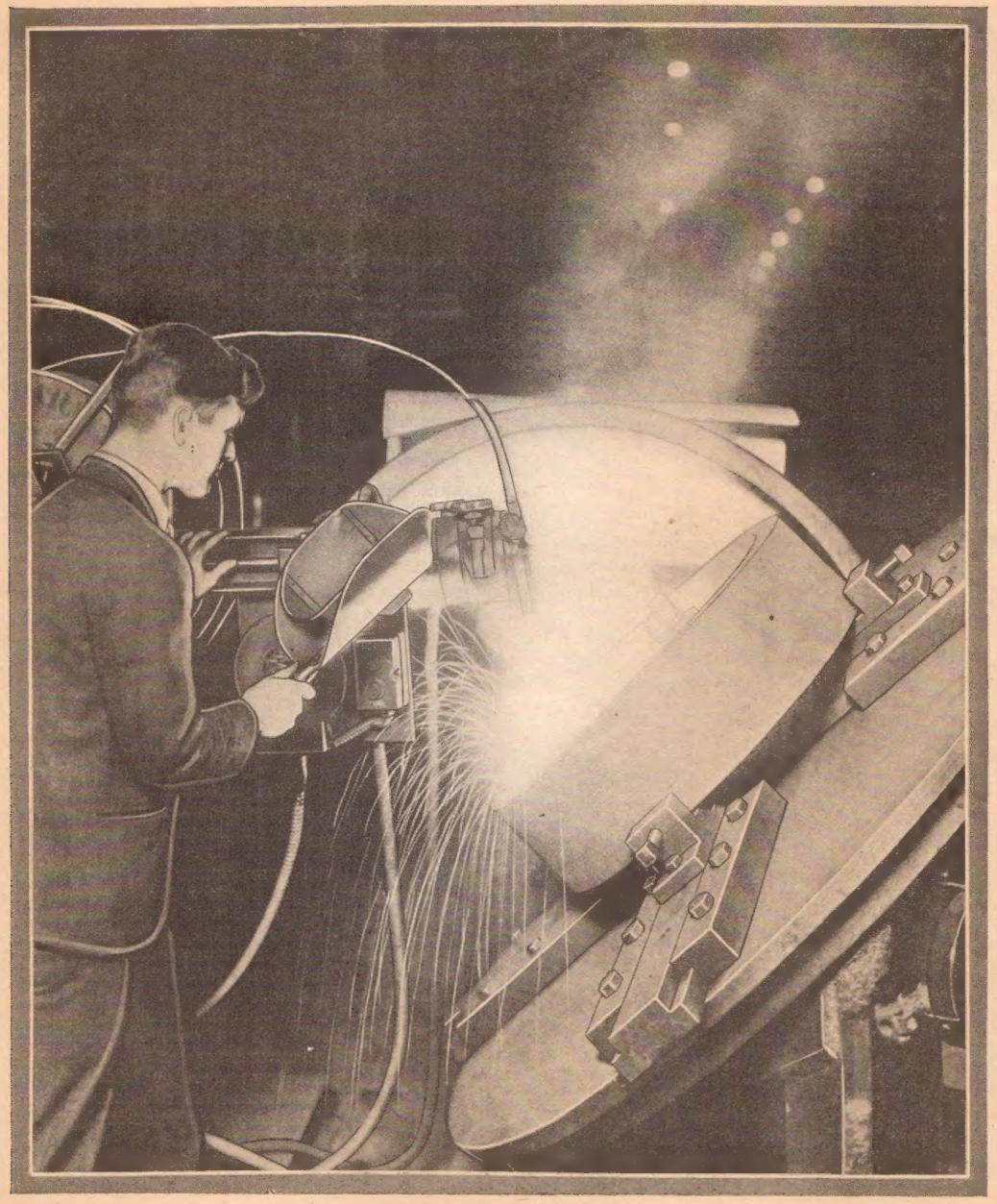
The Arc-Welding Automaton



The swift and quiet union of two pieces of steel as they pass under an automatic arc-welding machine at the East Pittsburgh works of the Westinghouse Electric and Manufacturing Company in endless procession . . . thousands of wheel-flanges for street cars, miles and miles of pipe, tons of sheet steel for innumerable tanks . . . the magic of this machine touches all industries

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A. DINSDALE, Managing Editor
T. O'CONOR SLOANE, Ph.D., Associate Editor
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Editorial

The Lure of Gold

GOLD is one commodity of which there is never an over-production. It is found in nearly every kind of rock, even limestone, and there is hardly a nation on the face of the globe that has not had its gold finds and its gold rushes, both large and small. Only a few of these gold finds turn out to be real mines worth millions of dollars.

For some time now, Samuel A. Boydston, an 87-year-old Confederate veteran of the Civil War, has been digging in the backyard of his home in Kansas City, Mo., in the expectation of locating a gold mine. The dirt in his backyard, when assayed, was found to give .04 ounces of gold, and .08 ounces of silver per ton. This, of course, is not a paying proposition, for the cost of handling the material is much greater than the value of the yield per ton.

But why all this discussion about gold?

Gold is accepted the world over as a standard of exchange. Silver has vied with it, but the price of silver is dropping very rapidly.

The subject of the disappearing gold supply is paramount among the bankers of the world. English financial circles fear the depletion of gold reserves. The Bank of France is increasing its reserve, thus weakening the Bank of England. The world slump has been laid by some to the exhaustion of the gold supply and by others to the silver price drop. India is reported to have sold 100,000,000 ounces of silver in order to acquire gold.

Here are some paragraphs taken from the news.

An English banker, J. F. Darling, attributes the world's financial and economic crisis largely to the fact that one-half of the world is unable to buy what the other half has to sell because "a large part of their money for many centuries has been in silver," and legislation has created an unprecedented discrepancy between the value of gold and silver. He suggests backing silver with gold to restore its purchasing power.

Francis H. Sisson, Vice-President, Guaranty Trust Company of New York, is reported as having said:

"It must be admitted that a fairly strong statistical case has been made out by those who believe that the world's volume of trade is increasing faster than its gold supply."

Prof. Lionel D. Edie, of School of Commerce and Administration of the University of Chicago, says:

"Since 1913 the average annual addition to monetary gold stocks has not been more than $120,000,000. What becomes of the gold? The average per annum output of the mines has been nearly $400,000,000. Obviously about $280,000,000 per annum has gone either into the hoards of the Orient or into the industrial arts of the world. These forms of absorption have been much greater than had been supposed, and if they continue will again raise the question: Is the rate of world gold production adequate for monetary needs?"

Prof. Irving Fisher, one of the world's leading economists, anticipates a gold famine through the civilized world within a few years, causing a long period of price declines and successive business depressions.

This country holds about 4½ billions in gold, just about the combined holdings of France, England, Germany, Italy, Argentina and Japan, with France holding nearly as much as the others combined.

What then are the solutions which may be suggested?

1. The establishment of the silver standard and its maintenance. While gold today has a value of more than sixty times that of silver, over a period of many years, only 14 ounces of silver have been produced for each ounce of gold.

2. The discovery of a means or method of increasing the supply of gold, either by unearthing new veins such as those located in Canada or by a submarine research at the outlet of gold bearing streams. These streams have been washing down their gold for centuries and have been depositing much of the metal fifty to several hundred feet beneath the surface of the sea. The use of suitable diving chambers, such as those developed by Williamson, Lake and others, would open the field.

3. The development of a means for extracting gold from the waters of the ocean in paying quantities.

4. The substitution for gold of some metal, such as platinum, or the newly discovered "rhenium 75" or the other rare metals.

5. A method for cheapening mining operations so that they could be carried on at much greater depths.

6. Discovery of a method for dissolving gold which will be less expensive than aqua regia, or a means for producing the acids at a very slight cost. The acids could then be pumped into present mines, dissolving out the gold and other metals and be pumped back to the plant at a much lower cost than is required in present mining operations.

7. An ore locater which will electrically determine the location of a small or large body of ore and give a reading by means of a dial as to the quality of that ore. The locater should be capable of detecting deposits to a depth of several hundred feet. By its means buried Inca treasures, hoarded moneys, and valuable gold accumulations buried in the tombs of Egypt, might be brought into circulation again.

The field opens up possibilities for the engineer, geologist, chemist and the research worker.

We predict another gold rush—and soon.

Editor

"Those Who Refuse to Go Beyond Fact Rarely Get as Far as Fact" - - - - - - - - HUXLEY

You call it an *Automobile*

But-

we call it *apparatus* in Ethyl laboratories

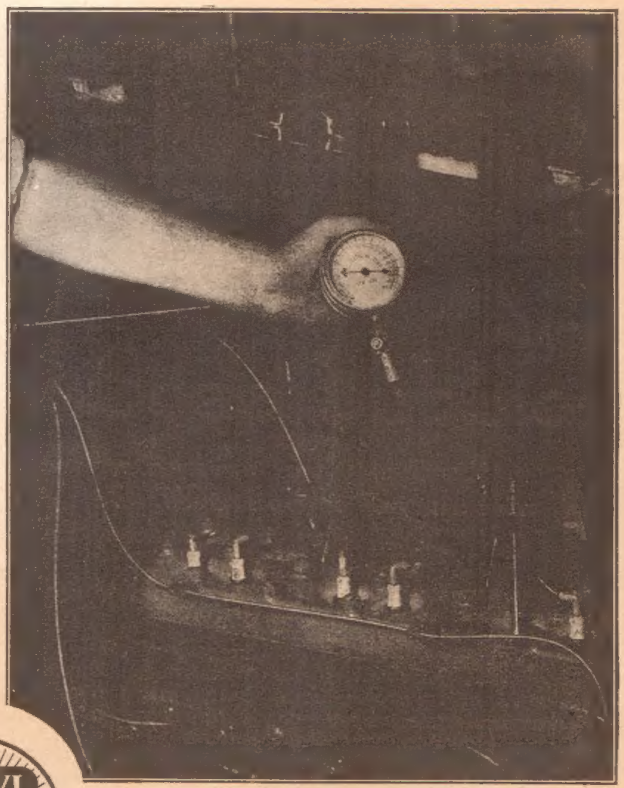
FROM the garage doors of the Ethyl Engineering Laboratory in Detroit—cars come and go. Stock cars, special cars; cars like the one you drive today and like the one you'll probably drive tomorrow. They are a part of the *apparatus* that engineers of the Ethyl Gasoline Corporation use in their everlasting search for fact.

During the past three years over 500 cars have been purchased, many of them worn out and destroyed by gruelling tests that tell the facts about motor fuel.

These tests prove that Ethyl Gasoline gives more power, that it takes better care of your car, that it does not "knock" and that it is admirably suited to the needs of *any* car sold today.

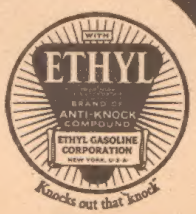
Tests prove that *any* good gasoline is made better by adding a few drops of Ethyl fluid; that this valuable fluid will control the combustion of *any* good gasoline so its power will be delivered in smoothly increasing pressure to the pistons, bringing out the best performance of any motor.

All Ethyl Gasoline is made from *good* gasoline. It all contains enough Ethyl fluid to *control combustion*. Try it yourself *from the pump that bears the Ethyl emblem*. You will like it. Ethyl Gasoline Corporation, Chrysler Building, New York City.



Taking the compression pressure of a stock model car with special head. 175 pounds compression is a much higher pressure than that of any car on the market, and this engine is operating satisfactorily on Ethyl Gasoline.

The active ingredient used in Ethyl fluid is lead.



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ETHYL GASOLINE

APRIL, 1931
WHOLE NO. 216

Science and Invention

VOLUME XVIII
NUMBER 12

Who Said— "No More Gold Rushes?"

"No More Interesting Theme Has Ever Presented Itself Than That of Gold, Man's Pursuit of It Through the Ages, Its Rise to Dominance Through These Last Eighty Years, and Speculation as to Its Behaviour for the Future."—John Hays Hammond

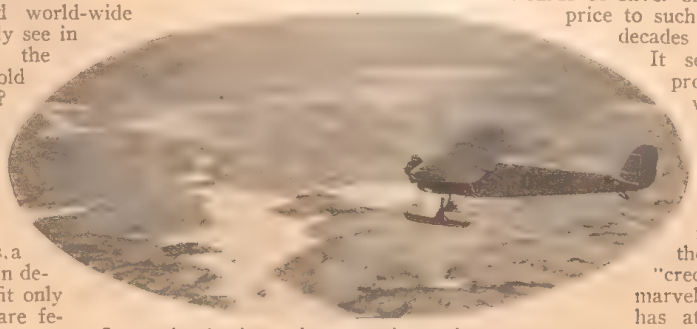
By Orville H. Kneen

WHEN an international group of bankers and economists recently made its report to the League of Nations, after long and exhaustive study, the whole world suddenly awoke to the fact that we are rapidly getting short of gold! And the shortage is already affecting the lives and happiness of every one of us.

One after another, in recent months, economists and financiers have warned us: "You cannot expect lasting prosperity again, really good times and expanding industry and high wages—unless you find more new gold and recover some of the billions being hoarded or otherwise kept unavailable for money and credit."

Why this sudden and world-wide lack of gold that we rarely see in circulation? What are the chances of more great gold rushes, as in the past? These questions today receive more international attention than any other subject—not even excepting disarmament or bolshevism.

The Russians themselves, a few short years after Lenin derisively pictured gold as fit only for "decorating toilets," are feverishly scouring their vast unexplored areas for the glittering metal that will save them from starvation. In every "capitalist" country other scores of gold hunters go forth, many of them by airplane, and equipped with every known means of detecting outcrops, studying sub-surface geology and looking for gold indications.



Prospecting in the modern way—by airplane. A view of "the barren lands" between Athabaska and Great Slave Lake, Canada.

Excepting only China and a few small nations, every country today is on the gold standard. Millions in golden billets that never see the light of day back up billions in paper money. For every $100 of credit used in transacting business, something like $7.50 in solid gold is securely locked up. By agreement, an even greater credit is to be permitted per dollar of stored gold. But still there is a shortage of gold, to keep pace with ever-expanding trade.

One reason is that China, Persia, and other silver-standard nations, are getting tired of silver's fluctuations and resulting troubles. They hasten toward solid, stable, one-priced gold. Worth $20.67+ per Troy ounce the world over, gold, it has been said, is "the only substance that is freely accepted in return for all services and in exchange for all other kinds of property by every race." It was the recent adoption of the gold standard by India that threw vast hoards of silver on the market, forcing the price to such depths that it may take decades to recover.

It seems fantastic that our prosperity, our jobs, high wages and living standards and happiness should suddenly be hanging on the success of adventurous geologists, prospectors and engineers. But it seems that we are at the end of an eighty-year "credit rope," which, after a marvelous series of gold strikes, has at last ceased to extend. John Hays Hammond, who has helped to produce more gold than any other man, pointed out some time ago in "Nation's Business" how our Golden Age began.

"Marshall's discovery," he said, "initiated the era of outpouring of gold which gave the world its first abundance of money. Upon that money largely has been built an immeasurable expansion of its industrial activities. Silver was the chief money metal for 2,000 years before James Marshall. There was a painful shortage of silver. Civilization advanced slowly because it lacked money. When Spain brought back shiploads of silver from Mexico, the

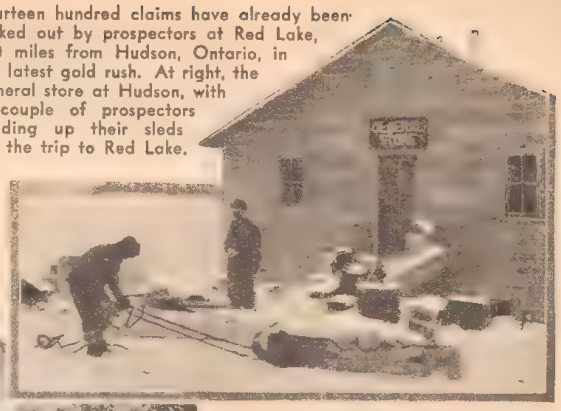
greatest era of development the world had ever known followed. As gold became plentiful, so did money. Innumerable enterprises that had been sleeping through the generations were awakened. The age of stupendous development has resulted."

If a sudden great gold strike were made tomorrow, it is safe to predict that our hard times would vanish almost overnight. And if the world's richest mines were suddenly to play out, chaos would ensue. Never since the days of 1492, when Columbus stepped off his boat and inquired where gold might be found, have men been more interested in the chances of new world-shaking gold rushes. Finds of importance make the front pages of every newspaper. A second California, Cripple Creek, Australia, Alaska or Klondike would cause a stampede that would make those rushes look like a Sunday School picnic.

Prof. Thomas T. Read, of Columbia University School of Mines, is one of those who forecast a declining gold output. He doubts the likelihood of big new bonanzas. Some feel that the earth's surface has all been explored, its gold mostly discovered. And yet the fact remains that time after time the world has survived just such gold-famines. Every continent has produced quantities of gold—and the areas still hidden beneath tropical vegetation or other effective cover, and totally unexplored for gold, run into hundreds of thousands of square miles!

Even in prospected areas, no one knows certainly, until he has drilled or driven a shaft, what treasure may lie beneath his feet. Though the older mines inevitably tend to run out, newer and even richer lodes and veins replace them. For the past decade the total output has steadily increased, and some of the many new strikes constantly being discovered may become as great as any of the past.

It was in 1909 that the richest field of our day began its glittering career. The story of its finding is a romance of the north country, where perhaps the greatest chances lie for the billions of gold the world is seeking. Two young chaps set out in that year from Cobalt, Ontario, one of the world's richest of silver camps. Knowing a little about gold, and grubstaked by a bartender, they headed into the northwest, where a few gold finds had been reported.



Fourteen hundred claims have already been staked out by prospectors at Red Lake, 150 miles from Hudson, Ontario, in the latest gold rush. At right, the general store at Hudson, with a couple of prospectors loading up their sleds for the trip to Red Lake.

Above—Camp construction amid ice and snow in the Matachewan district, near Bannockburn, Ont., where operations will be centered on the gold strike discovered by Bert Ashley and Bill Garvey, who are visible at extreme right. Left—Staking a claim at Stag Bay, Labrador.

Above — Panning for gold near Virginia City, Montana. Many prospectors are searching for gold in this manner in the Rockies. Everything in the pan that glistens is gold. Right—A gold pan with $10,000 worth of gold from Telegraph Creek, British Columbia.

"Benny" Hollinger and Alex Gillies had not put a hundred miles of scraggly bush behind them before they met an old prospector, Bill Davidson. He invited the boys into his log shack, and showed them his claims, on which he was doing his assessment work. Then he suggested they stake out some "nice looking outcropping of quartz" that he had seen near by. It lay close to the old portage route, over which thousands had tramped their weary way for many years, and still did.

The boys agreed to try their hand. They tossed a coin, and Benny lost, getting the location that looked least promising. Soon he was hard at work, stripping away the top cover of earth, tracing as best he could the white quartz that at this point came to the surface.

Thus was found the Hollinger, one of the world's richest treasure hoards. Year by year its output has steadily increased. The Porcupine area may become the chief source of gold, for it aided mightily last year in putting Canada ahead of this country for the first time. Now only South Africa finds more golden treasure than does Canada—and more remarkable still, in this Porcupine area almost one-third of the annual production becomes net profit! In twenty years its output has risen from $15,000 to over 40 million, and the grade of ore is as high as it ever was, though

This gold nugget, which weighs approximately eight pounds, is valued at $1,500

the shafts go down and down.

Over a hundred miles of underground passages in the Hollinger mine still trace the golden threads in the everlasting treasure hunt. At one of the near-by mines a huge shaft is being sunk to 4,000 feet.

The earth's heat in this region increases much slower than elsewhere, only one degree F. for every 300 feet of depth.

Oddly enough, only a few steps from his bonanza, which has since yielded over a quarter-billion, Benny Hollinger stumbled on an old test pit, long covered with weeds. Near by was a prospector's rusty anvil. Years before, no one knows how many, some unlucky and perhaps untrained prospector dug down, within inches of an incalculable fortune.

Hollinger staked one claim for a friend that sold later for $600,000. Benny himself got only $330,000 for his find, as he sold out in the early rush. Half of this went to the bartender who had grubstaked him. This "lucky dog," however, had to "divvy" with his brother-in-law, to whom he had sold half his interest for $75. It was a real tragedy for Hollinger and his heirs when he decided to accept all cash for his interest, instead of part cash and 50,000 shares in the company.

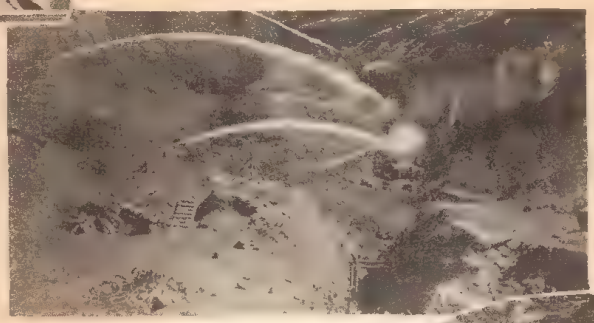
Two thousand years before King Tutankhamen's reign the Egyptians washed free gold from the sands, or heated quartz with fires and shattered with cold water the gold-bearing rock. Kings waged long and bloody wars to gain or regain golden hoards. Long before the discovery of America the natives of the New World were expertly panning gold with their wooden *bateas*. White men panned gold for the first time at Panama in 1502, on Columbus' fourth voyage.

The Spaniards' Colombian mines were for three centuries the world's gold source. Spain's abundant money, from Mexican silver, sent men and ships to the ends of the earth, and the world began to move. Since 1492 over 21 billions have been wrested from Mother Earth.

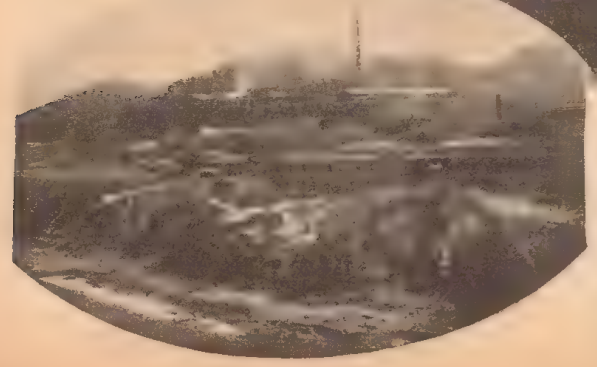
In 1849 James Marshall found his glittering flakes in the millrace. The California gold rush was the greatest of all time, and it, too, just prevented a gold famine. The first quantity-production of gold, it began an industrial era that still expands, for we learned how to store our gold and issue paper certificates. Credit has built a new world, but gold, great quantities of it, made credit possible.

Then, only two or three years after the California strike, two miners picked up three pounds of gold in an Australian stream. And the world was electrified when another stream yielded the two richest nuggets of all time. Weighing nearly 200 pounds apiece, each about the size of three common bricks, together they were worth nearly $100,000!

Since then one rich field after another has postponed from decade to decade the famine so often feared.



Native labor sluicing for gold at Edie Creek, in the uttermost wilds of New Guinea. High power hoses wash away the earth, and the free gold is left in settling pans. The native boys are paid $1.50 per month. Not the least of the many dangers encountered in this region is cannibals.



Above—Men at work in a placer mine near Grant's Pass, Oregon, one of the largest gold mines in the country, where gold nuggets are found. Left—Gold and copper mines at Mount Morgan, in Central Queensland, where the richest deposits have been located. Note waste dumps in foreground.

In 1875 men found gold on the Indian reservation of South Dakota. The rich Homestake mine still adds heavily to the supply. In 1891 a hopeful cowboy dug into a lode near Colorado's Cripple Creek that quickly made "Poverty Gulch" worth over half a billion dollars.

In the ancient river channels of California and Colorado, say mining experts, still remain hundreds of millions in gold. Often covered with deep layers and ridges of lava, and largely cemented, this low-grade ore will some day yield fortunes, just as the mining companies cleaned up after the placer miners had moved on. In many places today the search goes on for "lost placers," unfound gravel, and gold washed away from known lodes.

In 1886 George Walker, engaged in building a South African house, stumbled upon the outcrop of gold-bearing strata, an upturned delta of an ancient river, that came to the surface *at only one point*. Since that luckiest of all finds, the Witwatersrand has produced over five billions in gold. Year after year some fifty miles of gold mines turn out half the world's gold output.

In places today these great mines, such as the Village Deep, are a mile and a half below the surface, still pursuing the elusive golden threads, so fine that they cannot be seen with the eye. This richest deposit of gold probably will produce for half a century more. Once more the gold famine was averted for decades.

Then came the great Klondike rush and other finds, such as those of Alaskan placers in 1904. The Treadwell, begun about 1880, proved far more productive than most river-beds, for the valuable gravel was followed down and under solid rock. Only in the last few years has it played out. California and New Zealand have had similar placers under the rock, which in former volcanic ages covered the open stream-beds.

Placer deposits of gold-bearing gravel and sand, were all formed by gravity and flowing water, which carried away the remnants of primary deposits. Every placer, whether in a gulch, canyon, valley, ocean or lake beach, or glacial drift, thus indicates the existence of "mother lodes" above, which often can be traced.

The concentrating pans at the New Goch Mines, Johannesburg, South Africa.

Gold from surface placers is today less abundant. But who knows positively that no more rich stream-beds are to be found in unexplored regions? The airplane today reaches places once inaccessible, and flying geologists and prospectors may some day uncover another Klondike. Thus the Geological Survey of Canada reports that *"placer gold occurs along some part of nearly every stream in Yukon river basin."* It goes on to say that the Yukon gold output comes almost entirely from placers which have furnished about $180,000,000, nearly all from the Klondike district.

The same authority notes that "highly productive placer fields have been discovered throughout the interior of British Columbia . . . one small bar near Yale produced in a few years not less than $2,000,000. Cariboo district has produced more then $45,000,000 and continues to yield considerable amounts. On Cedar Creek a richly productive area was discovered in 1921 in a district that has yielded intermittently since 1860. Fine gold occurs on *almost all rivers in Alberta* running eastward from the Rocky mountains."

John Hays Hammond, perhaps the greatest gold seeker of all time, terms Canada "a bright spot on the gold map." Every year many finds are made in the pre-Cambrian rocks, the oldest on earth, that cover most of the Northland, and contain more minerals than any other formation. The Ontario Department of Mines reported recently that the "Bannockburn" strike in northern Ontrio has "free gold plentifully scattered through the quartz;" also, showings that "are remarkable for the amount of visible free gold," in an area found to be geologically favorable for gold.

On the west coast of Hudson Bay, at Term Point, one of the richest pockets of gold ever discovered was reported a year ago. Some 700 pounds of rock yielded $10,000 in gold. Near Kalgoorlie, Australia, whose "Golden Mile" has produced millions, torrential rains last August removed a few inches of soil and revealed more rich quartz reefs. This known gold area had been combed for years. Australia has given up three billion dollars in eighty years. To encourage prospecting, its government has now offered a bonus of $5 an ounce for all gold in excess of the 1929 production. As the standard price of gold the world over is $20.67+ per ounce, the bonus of 25% should greatly stimulate the search for gold that doubtless lies in many unrevealed spots.

How the engines of prospectors' airplanes are heated in the far north of Canada in winter. Inside this wood and canvas shelter a plumber's stove supplies the heat.

Another method of warming up an engine. A stove is placed under the engine while the canvas screen, reinforced with an eiderdown, is used to break the wind.

About a year ago a mining engineer, after many months of investigation on the island of New Guinea, north of Australia, reported that the Edie Creek area will become one of the great gold fields. He saw miners making $3,000 per ton of ore, and some cleaned up 100 ounces a day each, with primitive equipment. An ounce brings $10 at the mines—$1,000 per man for a day's work! Airplanes hurdle the terrific obstacles of the jungle, carrying men, food and equipment, even gold, to and from the gold plateau, 7,000 feet above sea level.

Years ago a young prospector and his burro, ranging the sagebrush deserts of southwest Nevada, ran into an old desert rat who offered him a half interest in his claims if he would have some samples assayed. Lacking the $8, he induced an assayer to

(*Continued on page* 1131)

Weighing gold bars in a Rand Mine, South Africa. The 21 bars seen on the hand truck weigh approximately 17,500 ounces, and are worth about $350,000. Altogether, there is well over half a million in gold visible in this picture!

Canned Sunshine for Live Stock

Ultra-violet Rays Have Been Successfully Employed in Treating Diseased People. . . . Now Scientists are Irradiating Goats, Cows, and Poultry, and Securing Remarkable Results

By Gene A. Day

IN a Wisconsin dairy barn the writer saw a pair of Holstein cows basking in artificial sunshine, the short wave lengths of ultra-violet from a quartz-mercury vapor lamp. In a neighboring henhouse pullets and hens were enjoying similar solarium treatment. In the stable of midget dimensions several goats were sunning themselves indoors, despite the fact that rain was falling in torrents outside.

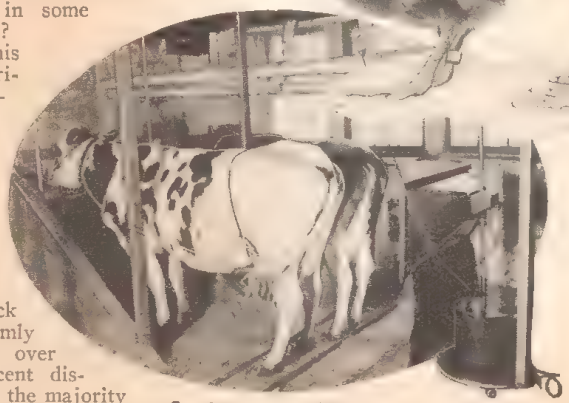
In wonderment he gazed and gazed. Had a new and novel era dawned in farming? Had he been asleep like Rip Van Winkle, and just awakened to find stock farming engaged in some special scientific jamboree? Then he recalled that this was not an ordinary American stock farm, but the experimental farm of the Wisconsin College of Agriculture, where Dr. Harry Steenbock was carrying on co-operative experiments to determine the effects of irradiation on milch goats, dairy cows and poultry.

Doctor Harry Steenbock is the scientist who calmly refused a fortune of over $1,000,000.00 for his recent discovery of how to irradiate the majority of the commercial food products now used by man. Instead of capitalizing on his scientific find, Dr. Steenbock followed in the footsteps of Dr. S. M. Babcock, another Wisconsin University experimenter, who originated the Babcock test for butterfat, and gave his discovery to his college.

What does ultra-violet research mean to the stockman and farmer and hen-husbandryman? Can the dairyman give his cows daily artificial sunshine baths under the quartz mercury lamp and increase their yield or improve the sanitary quality of the milk? Will an irradiated milch goat yield twice as much milk as an untreated Toggenburg? Is the cackle of the pullet any more golden because she enjoyed an ultra-violet "bath" just before laying her last egg?

Exposing pullets to ultra-violet rays increased the hatchery of eggs, egg yield, and produced stronger eggshells.

Both these chickens are the same age. The larger one was hatched from an egg laid by an irradiated pullet; the smaller came from a non-irradiated pullet, and was rachitic.



Sunning cows with quartz mercury vapor lamps. Feeding cows irradiated yeast increased their anti-rachitic content 48-fold.

Dr. Harry Steenbock of the University of Wisconsin, who refused $1,000,000.00 for his discovery on how to irradiate foods.

Ultra-violet research concerns the farmer chiefly because it seeks to solve more of the secrets of light, and particularly sunlight, one of the greatest assistants and assets of successful agriculture. Without sunlight, the farmer would soon be forced out of business. It is the power which grows crops, cures hay and grain, produces truck and fruit, and aids him from the sunrise of spring until the twilight of autumn in wresting a living from the soil.

The Wisconsin investigators inaugurated original ultra-violet research as a result of calcium assimilation tests with milch goats. Those particular feeding trials showed that fresh green plants such as soiling crops fed to experimental goats, confined in pens where their animal metabolism could be studied, resulted in lime assimilation and retention. Research divulged subsequently that the ultra-violet in sunlight was the true cause of this lime assimilation by the goats that received the green feed. Under Dr. Steenbock they sought to ascertain if vitamin-D, the antirachitic sunshine vitamin, would accomplish agricultural magic in milk, meat and egg production.

"At this time we do not know how ultra-violet rays can act in connection with calcium assimilation," said Dr. Steenbock, "but we do know that under certain conditions, calcium cannot be assimilated from the food, no matter how abundant it (*Continued on page* 1152)

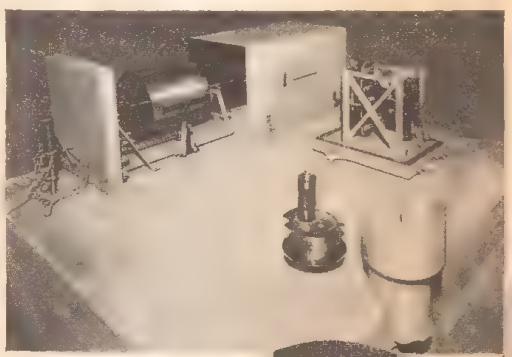
When the

The Subterranean Character of Mother Earth Is a Constant State of Unrest. This Condition, Recording as It Does at Seismic Stations, Gives Us Many Interesting Facts About the Earth's Core and Crust

View along a canal through Tokio, as seen after the great earthquake in 1923. Great fissures like these frequently open up in the ground during severe earth tremors.

SIR JOHN MILNE, one of the pioneers of modern seismology and the inventor of one of our modern seismographs which bears his name, made the remark that spiders caused more earthquakes than any other known cause. It sounds like a straw breaking the camel's back! He referred, of course, to the artificial earthquakes recorded on a seismograph by spiders roaming about its delicate parts. Spiders have an extraordinary affinity for seismographs. One such creature took up residence in one of the Fordham instruments and produced a series of beautiful quakes—quakes not recorded on the other instruments. An investigation disclosed the web on the pendulum, but no trace of the spider. The instrument was taken apart and every nook and cranny searched, but to no purpose. The instrument was reassembled and the final adjustment was being made when the suspension broke and the weight fell, and as it did so the spider scurried away. It had hidden away in an impossible corner and only the jarring of the fallen weight dislodged it.

But what is a seismograph, and what does it look like, one naturally asks? A seismograph is an instrument for recording earthquakes, and is a pendulum, much like the pendulum of any clock. The pendulum is delicately suspended and when the ground moves suddenly beneath it, as happens in an earthquake, the pendulum lurches. The same thing happens in a subway train. If the train starts up suddenly, a person standing in the train lurches backwards. What actually happens is this—the person stays still while the train moves from under him, and unless he grasps some part of the moving train he is likely to find himself on the floor. If the train stops suddenly, the person lurches forward—the train stops and the person keeps on going. This lurching is due to a property that all bodies, animate and inanimate, have. It is called inertia, a Latin and polite name for laziness. Four out of five are said to have pyorrhea—five out of five have inertia! Inertia is defined as the property in virtue of which a body when at rest resists being put in motion, and when in motion resists being brought to rest. We hate to go to bed at night, but when we are there we hate to get up in the morning. We resist being moved, but when once moved we resist being stopped. The pendulum of a seismograph resists being moved by the earth and stays at rest, at least for a while. This slight lurching of the



Two seismographs at Fordham University. Above—The Galitzin type, which records photographically and has a magnification of 1,500. Right—The Weichert mechanical type, magnification 80. Below — A ruined bridge after the great Japanese quake. Note how stream is diverted.

Vesuvius in eruption. Such eruptions are frequently accompanied by earthquakes.

Earth Quakes

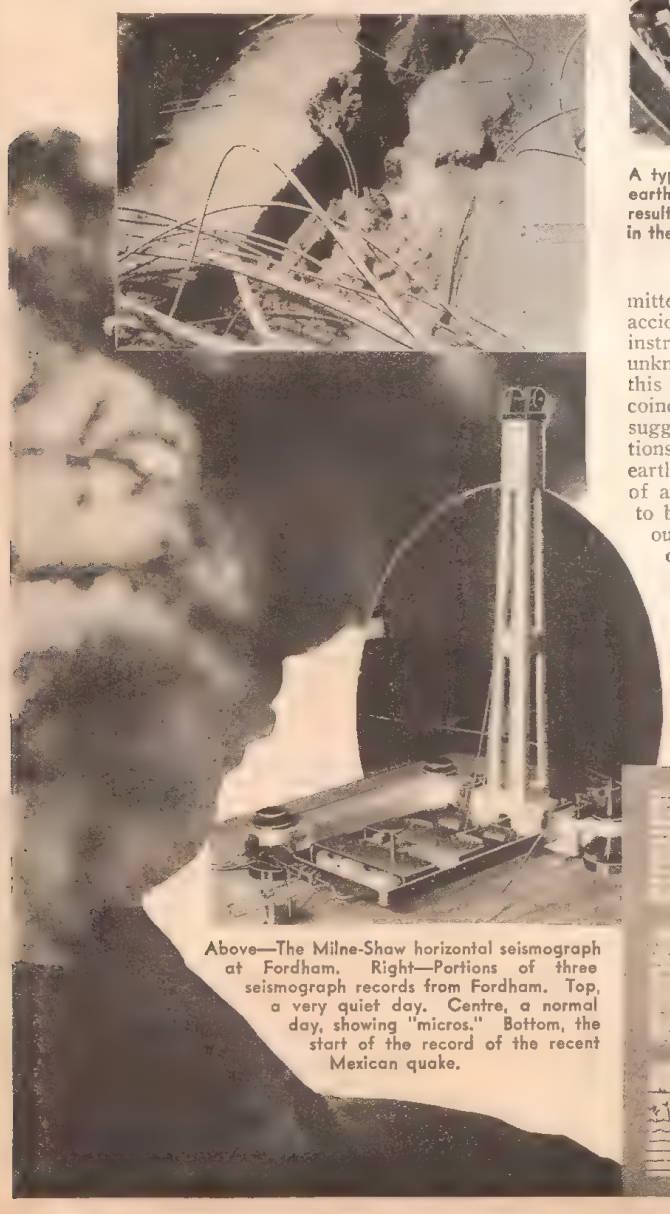
By
Rev. Joseph Lynch, S.J.
Seismic Station, Fordham University, New York

A typical earthquake scene, taken in Messina, Italy, after the 1908 earthquake, showing the very complete devastation which so often results when the earth's crust heaves. Left—A deep, vertical crack in the earth at Yokohama, big enough for a man to fall into, a result of the Japanese earthquake.

pendulum due to its inertia is magnified by mechanical, optical or electrical means. Just as the biologist has his microscope, so the seismologist has his magnification devices, the more modern of which magnify the motion of the ground about 2,000 times.

But does the ground move here in New York when there is an earthquake away off, say, in Japan? Yes, it does, otherwise we could not record such a quake. The discovery of this fact that the motion of an earthquake is transmitted throughout the entire earth was the result of an accident. A Russian astronomer was adjusting his transit instrument at Pulkowa, but the mercury level for some unknown reason was in constant agitation. The time of this peculiar vibration of the mercury was later found to coincide with the time of a distant earthquake. It was suggested that the earthquake might have caused the vibrations of the mercury by sending out waves through the earth, just as a pebble sends out ripples over the surface of a pond when it strikes the water. This is now known to be the fact. When an earthquake occurs, waves travel out from it in all directions through the earth at the rate of a few miles a second. The waves from the recent Italian earthquake, for instance, reached New York and set the Fordham instruments vibrating some ten minutes after the shock at Naples.

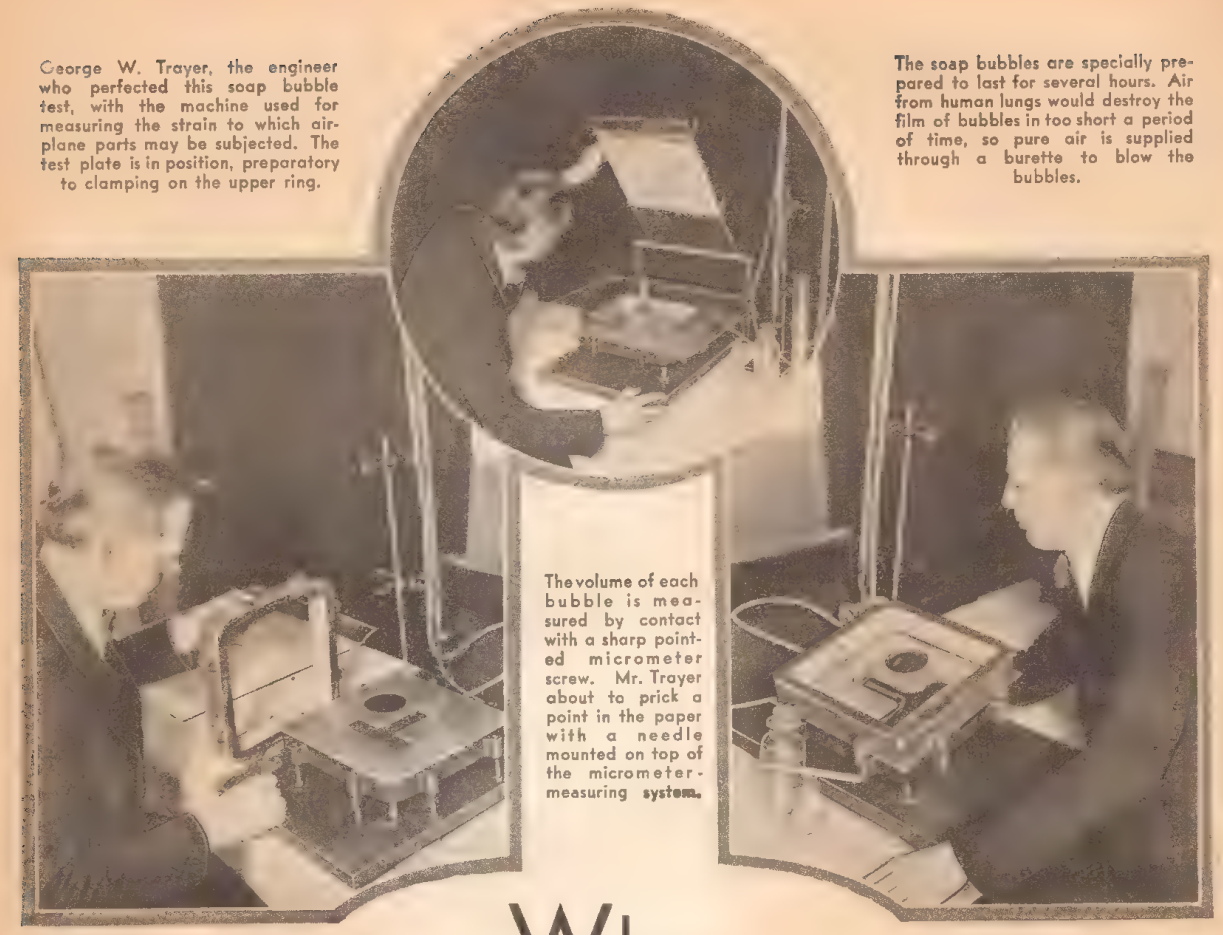
But how does a seismograph give any clue to where the waves come from? The vibration of the instrument would seem merely to indicate that there was a quake some place. The clue to the distance of the quake comes from another (*Continued on page* 1128)



Above—The Milne-Shaw horizontal seismograph at Fordham. Right—Portions of three seismograph records from Fordham. Top, a very quiet day. Centre, a normal day, showing "micros." Bottom, the start of the record of the recent Mexican quake.

George W. Trayer, the engineer who perfected this soap bubble test, with the machine used for measuring the strain to which airplane parts may be subjected. The test plate is in position, preparatory to clamping on the upper ring.

The soap bubbles are specially prepared to last for several hours. Air from human lungs would destroy the film of bubbles in too short a period of time, so pure air is supplied through a burette to blow the bubbles.



The volume of each bubble is measured by contact with a sharp pointed micrometer screw. Mr. Trayer about to prick a point in the paper with a needle mounted on top of the micrometer-measuring system.

When Scientists Blow Soap Bubbles

The Life of an Aviator May Depend Upon the Stress His Plane Wing Can Stand. Soap Bubbles That Last for Hours Are Now Being Used to Test the Twist Resistance of Steel and Wooden Structures

By Anthony Wayne

IF the life of your best friend depended on a bubble, his chances of survival might seem rather thin. Nevertheless, engineers of the government have been using bubble films in a series of very careful tests that may spell the difference between life and death for many an aviator in time to come.

The problem confronting the engineer was, simply, this: How much twisting can the wing beam of an airplane stand without breaking? Wings of planes in flight have been known to crumple and fail for no apparent reason. It is possible that an unforeseen wrench or twist, combined with an already severe bending stress, was responsible for some of these accidents. United States Navy aviation officers wanted to make sure of the safety of their constructions, in this regard, so they called in engineers of the Forest Products Laboratory of the U. S. Department of Agriculture to compile scientifically accurate figures for the twist resistance of all kinds and shapes of airplane wing beams. Such a question could not be answered satisfactorily by pure mathematics or accurately enough by ordinary mechanical tests. Some other method had to be worked out.

Some years ago a German physicist, in experimenting with soap bubbles, discovered that their air capacity is a direct measure of the *twist resistance* of a solid, such as the metal used in making airplane wings. So George W. Trayer, researth engineer, determined to utilize this fact. If only the bubbles could be made to last long enough for tests, and could be controlled scientifically, the problem would be solved.

The ordinary soap bubble, as we all know, is a fragile thing totally unsuited to standing the wear and tear of a hard day's work. Persistent effort resulted in the production of a specially prepared soap film that would last for a day under continuous measurements. This marvelous bubble was obtained by the mixture of triethylaminoleate and water and glycerine. Such a bubble was found capable of giving puncture-proof results that would last for hours.

The method of using the soap bubble as devised by Mr. Trayer was unique and practical. Take a beam of any shape (viewed end-on) that you please —square, triangle, oval, the letters I, H, X, T, L or what you will—and imagine this beam completely hollowed out and used as a pipe to blow bubbles with. Then blow the bubble out only far enough to take a sort of flat-pincushion shape. The

(*Continued on page* 1135)

Weighing the Earth

By Means of a Specially Constructed Torsion Pendulum, Adjusted as Accurately as Was Humanly Possible, Dr. Paul R. Heyl Established the Weight of the Earth at 6,000,000,000,000,000,000,000 Tons

By Martin Codel

MEET Dr. Paul R. Heyl, of the U. S. Bureau of Standards at Washington, the man who manipulates a few delicate instruments that lift old Mother Earth by her figurative bootstraps and show you within a few points of precision how much she weighs.

His fellow scientists listened with rapt interest a short time ago, at the annual 1931 meeting of the American Association for the Advancement of Science at Cleveland, when he told them how he does it and why. Dr Heyl didn't even consult a note when he rattled off figures running into twenty one-ciphers, in expounding his experiments and findings in weighing the earth. For he had been at the task from 1923 to 1929, and knew all its abstruse mathematical nuances by heart.

An interesting scientist who has done an interesting scientific job, you must agree he is, but, you will ask, of what earthly use can it be to anybody to know that Mother Earth weighs just about six thousand million, million, million tons—6,000,000,000,000,000,000,000, tons, if you prefer the figure written that way? Well, let Dr. Heyl tell you.

"In the first place," Dr. Heyl said in his address, "a knowledge of the mass of the earth is of interest to astronomers, for it is the starting point from which are obtained the masses of the moon and of the sun and of the other planets of the solar system. Our earth, therefore, is a natural standard of reference with which other quantities are compared; and it is the business of the Bureau of Standards to determine such fundamental reference quantities as accurately as possible.

"In the second place, a knowledge of the earth's mass enables us to learn something about the interior of the earth, that region about which so much imaginative literature has been written, and which no one can ever hope to investigate directly. From the earth's mass we can calculate its density, that is, the number of times it is heavier than an equal globe of water; and this leads us to a remarkable conclusion.

"The various rock materials which make up the outer layer of the earth, which are accessible to test and measure, turn out to have an average density between two and three times that of water, while curiously enough, the figure for the earth as a whole comes out about twice this value. The inference is obvious: the core of the earth must be composed of something much heavier than the outer crust."

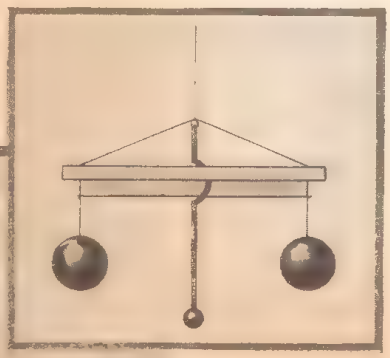
The question is this: Of what is the core of the earth composed? Knowing its specific gravity, Dr. Heyl correlates that finding, with the speed of travel of earthquake waves, the phenomena of terrestrial magnetism and other facts, and tells us that "those who have given the most attention to the subject conclude that the core of the earth is a great ball of iron.

Quite frequently there are reports of the falling to earth of bodies known as meteorites, principally composed of metallic iron, sometimes with a stony mixture. These strange bodies seem to be floating about in space. Dr. Heyl tells us that the earth is like a great meteorite, the result of the accretion or massing together of many such articles. In the process of massing the heavier iron portions have gone to the center by virtue of their own weight, while the lighter stony portions form the surface layers.

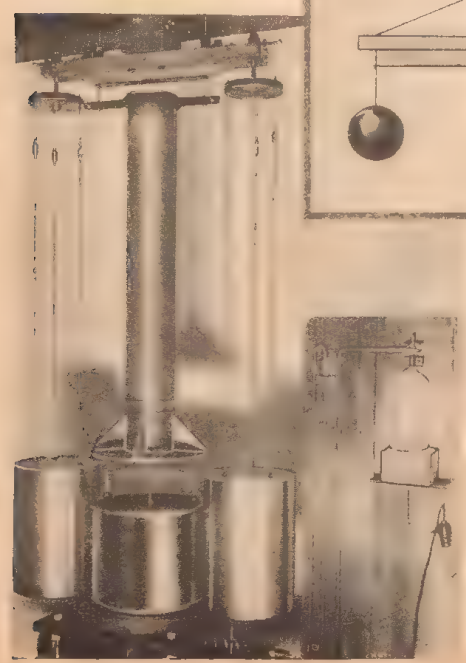
But how is the earth weighed? The process is simple in principle. Dr. Heyl thus describes it:

(*Continued on page* 1134)

Dr. Paul R. Heyl in his laboratory, taking readings of the oscillations of the torsion balance. So that the course of the delicate instruments would not be interfered with by moving masses, he worked forty five feet underground.



A torsion pendulum, showing the two balls suspended from a horizontal aluminum rod. The small object hanging beneath them is the mirror through which readings are made.



The instrument used for this experiment. To insure accuracy, the three turnbuckles on the suspending rods to the left and right, are provided to adjust the large steel cylinders.

A Raft of Bucking Logs Is Their Ocean Liner

By Murray Godwin

Top, left—The purpose of this "undercut" is to direct the fall of the tree so that it will not damage its own and other trunks and thus waste valuable timber. After the undercut is made, sawing begins on the opposite side, wedges being driven in back of the saw to keep it from binding. Above—Caterpillar Sixty with high wheeler and fair lead, hauling timber to water.

"LOOK out for her kick!" A word of warning is as good in a forest as in a corral—against a mule or a tree, for many a man has been knocked senseless or worse by the kick of a falling tree. The traditional tenderfoot in the woods thinks himself safe if he stands at a point opposite that across which the trunk will fall. But he will do well to reckon with the kick.

As the tree topples and the bole is severed, the butt shoots out across the stump with a force that would shake a brick wall. That is the kick, delivered, like the mule's, from the rear. Few woodsmen get in the way of it. Mostly they get theirs from the other end, while occupied with some task which absorbs their attention.

Falling timber represents only the start of the hazards of lumbering. Green timber is tough to handle. It was a lot tougher in the old days (which still persist in spots, however, as far as method is concerned), when axes, peavies, and ox teams were about the limit in woods equipment; but it's tough enough even with the most modern outfit that invention and finance can produce. It has a way of cracking up and throwing itself when being cut into logs. And, as logs, it has a habit of rolling unexpectedly when being decked or undecked for transport. Unloading a car of logs is sometimes suggestive of playing tag with a flock of dynamite. The logs will refuse to start under the expert poking and prying of a lumberjack with a peavey; then, apparently for no reason, they will fairly explode into action and thunder hellbent down the skids.

They act the same way in water. They will be piled and jammed house-high in a stream, apparently as immovable as the bed of the stream itself. It seems as though it would take a locomotive crane to get them going, handling most of them one by one. But somewhere in that disorderly pile is a log that will unlock the works. A jack probes with his peavey along the face of the pile, in portentous silence. He shifts a log here and there without disturbing the rest. Then abruptly he hooks on to the key log and scrambles for his life, for like a mountain having an attack of earthquake the whole structure commences to heave and tumble along the line of least resistance, downstream. To prank with logs and live long, a jack has to be as fast on his toes and between his ears as 'Gene Tunney, while wearing calked boots and carrying equipment that would be load enough for many a man.

In the days before power hauling equipment was generally available, the thing to do was to get logs to water with as little haulage as possible; for draft animals are slow everywhere, and especially in the woods, even with seasoned timbermen to cuss them out. If a stream deep enough to float a log lay within shooting distance—provided the logs were of a kind that would float, that was the goal of the frothing teams and cursing men. If the cut was on high ground, so much the better. A timber slide was built down the face

Getting logs to water by gravity in the modern style, by an overhead carrier operating on a cable way.

A raft of logs being towed down the Rhine to Rotterdam, Holland. Note the giant sweeps supported on temporary trestle work.

IN the Old Days the Logging Industry Was Full of Thrills and Romance. Life in the Lumber Camps and on Timber Rafts Was Crude and Hazardous in the Extreme, Yet Rollicking Withal. The Ever-Changing Location of Standing Timber, Together With the Introduction of Modern Machine Methods, Have Produced Many Changes in the Industry. But the Hazards Still Exist

Filling oil lamps for the night on the Rhine. Running lights mark the position and extent of the raft for the guidance of other craft navigating the river at night.

of the hill, and gravity was put to work. Some slides were miles in length.

Not infrequently a timber slide became jammed, or was cleared too slowly or incompletely at the low end. Then, likely enough, there was a collision, and a couple of fine virgin timbers turned themselves into kindling—but kindling somewhat too generally strewn over the landscape to be salvaged.

Timber slides are still used in the northeast and northwest logging districts of the United States. But they have been considerably improved in design to lessen the wear and tear on the timber. Lumber operators in general still regard water as a great potential help, but they are not so precipitous in their efforts to reach it. With our modern power, the hauling and handling equipment plentiful, and good timber on the wane, it pays to use a little constraint. Gravity makes transport cheap; but it needs to be controlled.

A cigar-shaped raft, composed of five million feet of lumber, held together by 115 tons of chain. Such rafts are towed 1000 miles down the Pacific Coast.

This timber raft crew hasn't far to go to get water to wash the dishes after the evening meal.

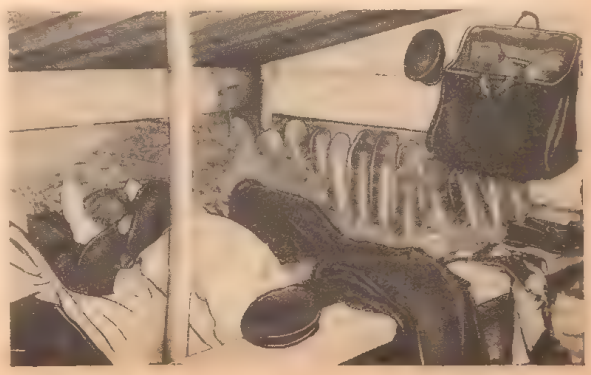
Timber slides often are nothing more than two parallel lines of straight logs laid closely together, each log in a line jointed smoothly to those adjacent. Far more elaborate are timber flumes, which in many cases traverse a whole series of hills, and are carried over low spots by carefully braced cribwork. Such structures are always built of sawed lumber, the flume itself taking the form of a trough, which must be tight enough to hold a stream of water: for the flume is actually an aqueduct, with a continual flow of water to float its cargo of timber to the lower end. For the big trees of the Pacific Northwest, flumes are hardly feasible; but they work efficiently with timber of smaller size, especially that destined for pulpwood.

Floating logs to the mill is still an economical method, if it does not involve too circuitous a course. Floating them to market is still good practice, too, in some parts of the world.

That means a raft. On occasion, also, it means plenty of blistering labor, excitement, and at times a smashing smash-up. Probably nothing in the way of a floating structure can smash up quite so abruptly and unanimously as a timber raft, given a fair chance.

A timber raft is big and awkward—even the smallest ones are that way in comparison with any kind of a boat. It is also loosely put together. Worse, it is dependent for locomotion on the current. Fore and aft are sweeps which serve as rudders and also as oars, but only in the latter capacity when sidewise movement is required. A raft can't back up, nor can it be turned speedily from its course, nor can its progress be accelerated save by the chance of a stiff breeze from the rear quarter. If something formidable threatens, all the crew can do is man the sweeps with all the back they've got, and if possible inch their timber out of the way.

"Towheads," sandbars, and shoals gave American raftsmen plenty of work and worry in the old days. On top of wrestling the craft down the river against these hazards, they had to give thought to the possibility of meeting a steamboat at an inopportune moment in an inopportune place. Sometimes a river boat, racing against time and rivals, climbed into the middle of a timber raft, in the dark of the moon. When that happened, it was overboard on the tick for everybody who was awake; whoever wasn't awake likely never would be. Often it wasn't easy to get over (*Continued on page* 1145)

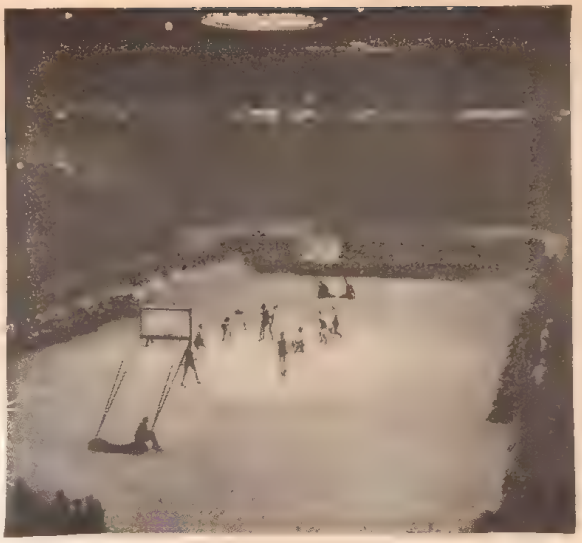


And so to bed. An interior view of the living quarters on a German timber raft. Note the ample stock of bread.

Fore-Runners of Modern Sport

Including the Gentle Sport of Hurling, and Early Skating, Which Resembled a Fight With Clubs—With Notes on Ping Pong, Nine-Pins and Other Ancestral Pastimes

By William Simonds



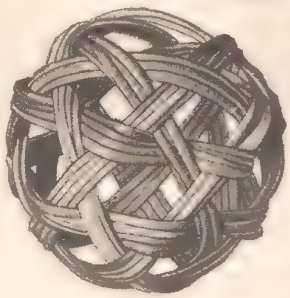
When 15,000 witnessed the basketball games in New York, they found a clear unobstructed view of the field. The back boards were of plate-glass.

IMAGINE yourself tramping cross-country in England, a couple of centuries ago. The weather is fine, the hedgerows are bowered with greenery in the shelter of which the birds wake the air with song. Blue sky, white clouds, trim blooming fields. A day of peace.

Suddenly there comes to your ears a savage murmur of human voices. Excited cries—*"'Ware east!" "'Ware west!"*—seeming to well up from beyond the bank of a clear, meandering stream. Curiosity, not unmixed with caution, urges you to depart from your path to investigate.

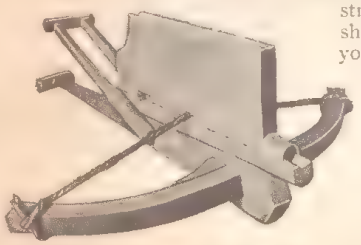
As you draw nearer the splashing of floundering bodies and frantic feet is added to the pandemonium of shouting. You reach a point of vantage from which you can see into the bed of the stream.

Squirming and struggling on the bank and in the water are scores of muscular provincial young men. Their clothes are torn and soaking, their faces are red and bruised. They thrust, trip, wrestle, heave—apparently in a rage of mass madness. Apparently it is a grand free-for-all, with everyone against everyone else. An inexplainable rural riot.



The original "basketball" woven out of stout twigs and used by the natives of Borneo when they played football.

Then you note that numbers of the young men are scrambling in a heap, and that this heap forms the center of the vast milling-around. Presently the struggle takes a new shape. Some of the young men mass and fling the prone, struggling bodies aside, rescue a battered individual from the very bottom of the pile, and ganging around him they begin to climb the bank, battling with the rest of the crowd every inch of the way.



A bow used in the Chinese archery contests in the eighteenth century.

Ice skate used by German hockey players in the year 1830.

They gain the top. They begin a march across the fields, pausing for a new free-for-all time and again, changing pace and line of march continually. The remainder of the combatants catch up, and the whole crowd struggles crazily into the distance by tortuous degrees. All at once, after a sharp collision, another group masses up in rude "interference," and the march begins to lead back to the stream again, no less ferocious in its accompaniment than before.

What was it all about? A "hurling" match! Actually this vast riot has all occurred in the course of a game played with great enthusiasm by rural England! In the tangled mess of fighting men are represented three or four parishes, or perhaps only two, out for a holiday's sport. The goals are points in each of the villages involved, and they are miles apart. A silver ball is the object of contention. It is thrown up for play somewhere in the fields about equidistant from the goals, and each individual tries to seize it and carry it to the opponents' goal. His fellow parishioners try to help him, as indicated. The prize is the ball itself, and fame.

In comparison with this, how tame and orderly seems our rugby football, with its numbered players and system of rules of today! You can see it was the same game—but with the lid removed. In hurling of the sort described, almost anything but homicide was good play!

The simple pastimes of our fathers! They seemed all to tend in the direction of riot and mayhem. A more confined game of hurling was sufficiently contentious to scare a devotee of

(*Cont'd on page* 1121)

The apparatus for the Spanish version of "ping pong." The ball weighs 4 pounds and the racquet 14 pounds.

This queer-looking bat worn by Italians when they played "Palone," a game which corresponds somewhat to tennis.

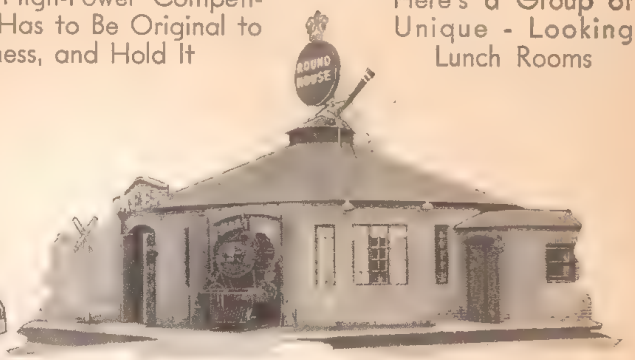
The World's Queerest Eating Places

In These Days of High-Power Competition, a Man Sure Has to Be Original to Attract Business, and Hold It

Here's a Group of Unique - Looking Lunch Rooms

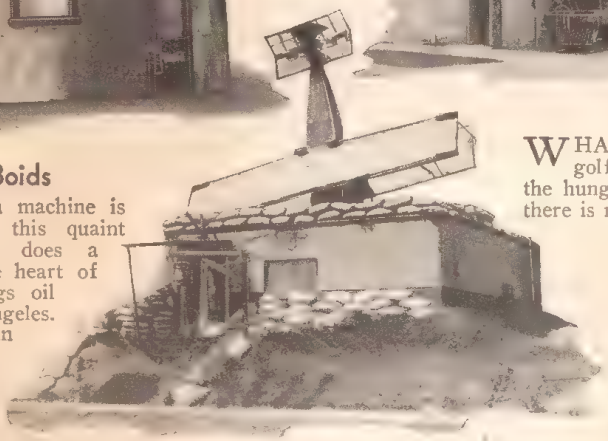
For Oily Boids

OILING the human machine is the function of this quaint lunch room, which does a lively business in the heart of the Santa Fe Springs oil fields, near Los Angeles. The spout of the can serves as a chimney.



The Round House

WHAT the Nineteenth Hole is to the golfer, this restaurant ought to be to the hungry locomotive engineer. At least, there is no dearth of local color.



Sailor, Ahoy!

IF this restaurant isn't doing a good trade it can only be because it isn't anywhere near water, and even then, landlubbers like their fads and fancies. A "lighthouse" like this, if anywhere near water ought, in theory at least, to attract every sailor for miles around.

Shades of War

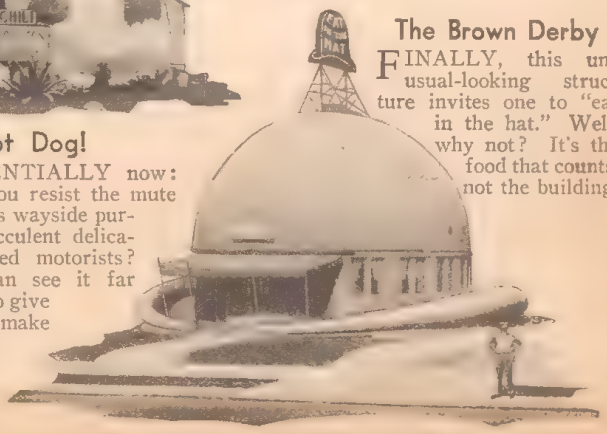
THIS looks so uncommonly like a dug-out that its appeal may perhaps be somewhat doubtful. However, the cracked-up plane may enlist the sympathy of aviators.

A Creamy Paradise

WELL, the oil workers, the engineers, the aviators and the sailors have all been catered for, so why not the milkmen and the ice cream merchants? It's all right with us.

Hot Dog!

CONFIDENTIALLY now: Could you resist the mute appeal of this wayside purveyor of succulent delicacies for tired motorists? And you can see it far enough off to give you time to make up your mind to stop.



The Brown Derby

FINALLY, this unusual-looking structure invites one to "eat in the hat." Well, why not? It's the food that counts, not the building.

"Oh, the battleships are mighty!
They're the backbone of the fleet.
The airplanes and destroyers
Are mighty hard to beat.
The armored cruiser squadrons
Are known by land and sea,
But any greasy sub-ma-rine
Is home sweet home to me."

Courtesy Triangle Radio Supply Co., Inc.

Behind the Scenes Submarine

By William

"THIS is George Hicks speaking from the bridge of the 0-8 in this special event broadcast, a presentation of the National Broadcasting Company and associated stations."

As these words echoed throughout the United States on a recent Sunday afternoon, nine young men wilted perceptibly and deep, deep sighs might have been heard had not the radio circuits been cut at the announcer's words.

Two and a half years' preparation had been culminated and for thirty minutes the nation (those who listened) had been aboard two of Uncle Sam's submarines and had experienced the sensations of a dive, torpedo firing and other submerged manoeuvres.

Not so with the six navy officers who provided the practical means and skill to make the program possible. Aboard the 0-4, flagship of the squadron, Lieutenant Commander Raymond A. Deming, commanding Submarine Division 2, United States Navy, smiled a bit proudly, nodded to Lieutenant J. W. McColl, Jr., skipper of the 0-4:

"Very good, run up the signal 'Liberty tomorrow' for the 0-4 and 0-8."

A few of the crew grinned. From the 0-8, two hundred feet to starboard, several arms waved and Lieutenant George C. Hern, commanding, megaphoned across the water:

"Thanks, commander. Do we return to the Base now?"

The radio staff began dismantling equipment.

In the galley of the 0-4 James Wallington, NBC announcer, was munching a sandwich and drinking excellent coffee. Beside him was Lieutenant Norman S. Ives, who had served as his observer.

W. R. Brown, assistant field supervisor for NBC, poked his head through the small aperture which serves for a door.

"Peck is copying a message from New York," he called. Sandwiches were forgotten—and all, officers included, hurried to the forward battery compartment where the portable short-wave transmitter and receiving stations were set up.

"P-r-o-g-r-a-m v-e-r-y s-a-t-i-s-f-a-c-t-o-r-y," read the group over Stanley Peck's shoulder.

"T-h-o-m-s-o-n c-o-v-e-r-s M-e-t-r-o M-o-n-d-a-y," etc.

The sounder continued tapping out instructions for the next assignment for the broadcast engineers. The submarine program had had its moment and broadcasting schedules for the hours yet to be were now of paramount importance. What they had accomplished was past.

After two years of seeking permission and proposing ways to accomplish the program, a staff of six engineers, two announcers and the writer started for the United States submarine base at New London, Connecticut. The group included, besides Wallington, Hicks and Brown, C. H. Campbell, A. R. Thomson, Charles C. Grey, Stanley Peck and C. M. Hutson, field engineers.

Captain Wilson Brown, commanding the submarine base, had assigned to Lieutenant Commander Deming the task of helping NBC to accomplish a project never before attempted.

He, in turn, asked Lieutenants Ives and Charles B. Momsen, who had assisted the broadcasters in another submarine program, to aid him.

The proposal was outlined to Submarine Division 2 and three of the nine 0-boats volunteered, the 0-8 first. The 0-4 was next, but at that time it was believed only one submarine would be necessary.

Prior to the arrival of the broadcasters, Deming had directed Lieutenant Horn to test the method tentatively suggested.

The idea was to establish a short-wave transmitting station in a surface craft which could trail the periscope of the submarine. A microphone cable, order wire and feed-back circuits were to be run by means of a rope or heavier cable between (*Continued on page* 1123)

Running the cable through the hull of O-8 via the scupper of the galley sink. The cable runs forward, outside the hull, to the bow and is attached by a stout rope, to the bow of O-4. The author of this article is seen in the left foreground, leaning over the rail of O-4, directing the work.

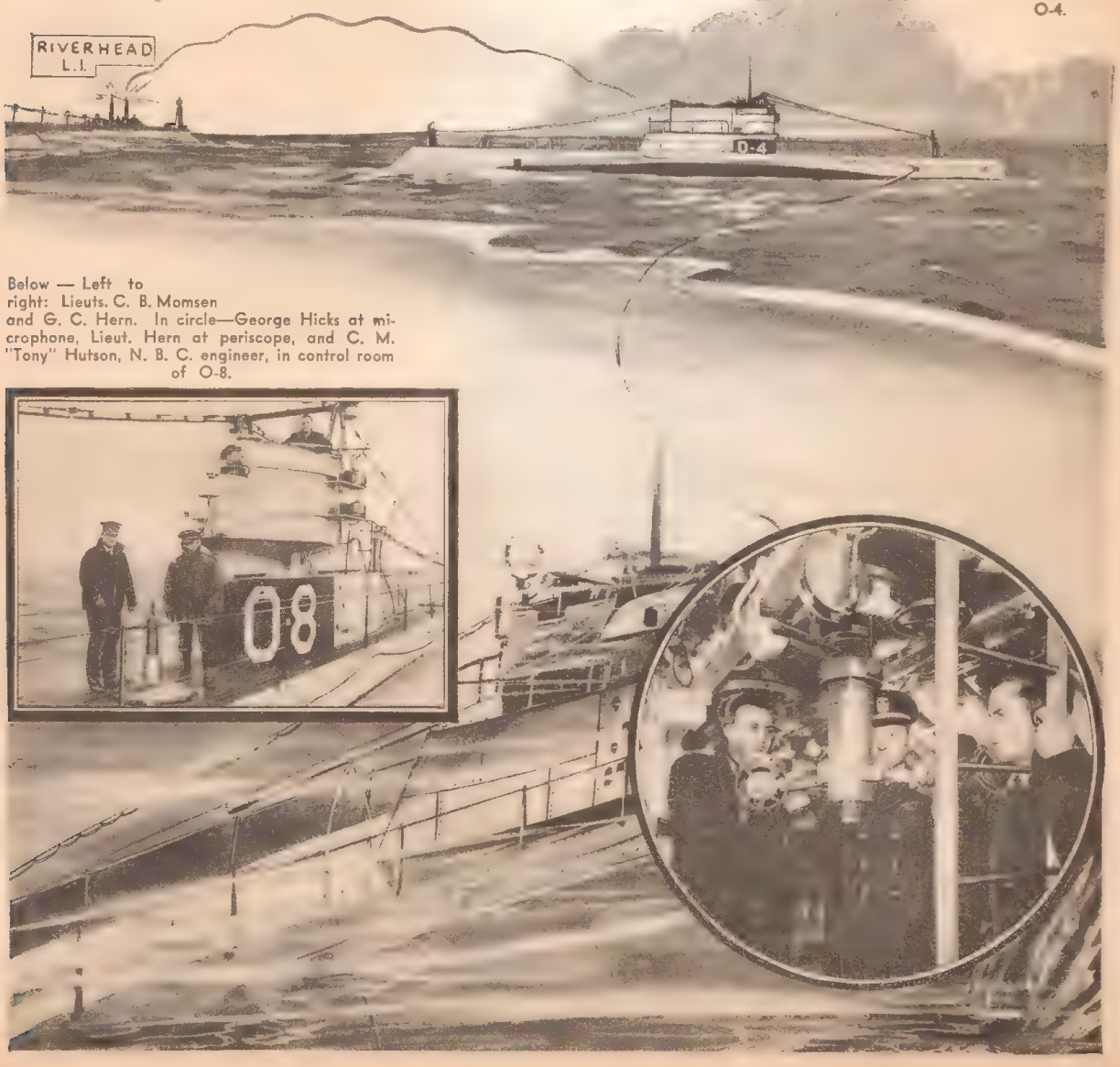
Radio Triumphed Again Recently When the Microphone Was Taken Aboard a Submarine Which Dived Under the Surface of Long Island Sound, Whence a Thrilling Description of the Many Sensations Was Broadcast to Listeners Throughout the Nation. This Article Describes the Experiences of the Announcers

# of a Nationwide Broadcast

Burke Miller

Director of Special Broadcast Events, National Broadcasting Company

The short-wave transmitter on O-4.



Below — Left to right: Lieuts. C. B. Momsen and G. C. Hern. In circle—George Hicks at microphone, Lieut. Hern at periscope, and C. M. "Tony" Hutson, N. B. C. engineer, in control room of O-8.

Sunlight Forms New Molecules

Radiations Effect Chemical and Physical Changes in Substances. Observe These Reactions in Your Own Laboratory

By Eugene Blank

THE amateur experimenter is no doubt familiar with the transformation of chemical energy into radiant energy such as light. The combustion taking place in an ordinary flame is such a transformation to some extent. The reverse transformation of light into chemical energy is not quite so well known and forms the basis for several very interesting experiments about to be described.

The transformation of radiant energy into chemical depends largely upon the wave-length of the incident radiant energy. Silver bromide or chloride for example, are acted upon most vigorously by the shorter wave-lengths, while the transformation of radiant energy into chemical, constantly going on in plants, attains its maximum in yellow light.

One of the most easily performed experiments showing the effect of light on the speed of a reaction is the test for unsaturated hydrocarbons in ordinary gasoline. Unsaturated compounds possess the property of directly adding bromine to the molecule. To ten cubic centimeters or so of gasoline in a dry test-tube add slowly a solution of bromine in carbon tetrachloride. Keep adding the bromine as long as it is decolorized and finally add an excess. Divide the colored mixture into two test-tubes, placing one in the dark and the other in bright sunlight. In a few minutes the tube placed in the sun will be colorless, while the tube kept in the dark will have undergone little or no change. The sunlight has literally knocked more bromine into the molecule.

Various so-called actinometers have been devised for the estimation of light intensity. If a solution of 4 grams of ammonium oxalate in 100 cubic centimeters of water is added to an equal volume of a solution made by dissolving 2 grams of mercuric chloride in 100 cubic centimeters of water and then exposed to strong light, white crystals of mercurous chloride (calomel) will precipitate. At the same time carbon dioxide gas is liberated. By measuring the gas volume or by filtering and weighing the precipitate the light intensity may be quantitatively determined.

Chlorine water yields oxygen when exposed to sunlight.

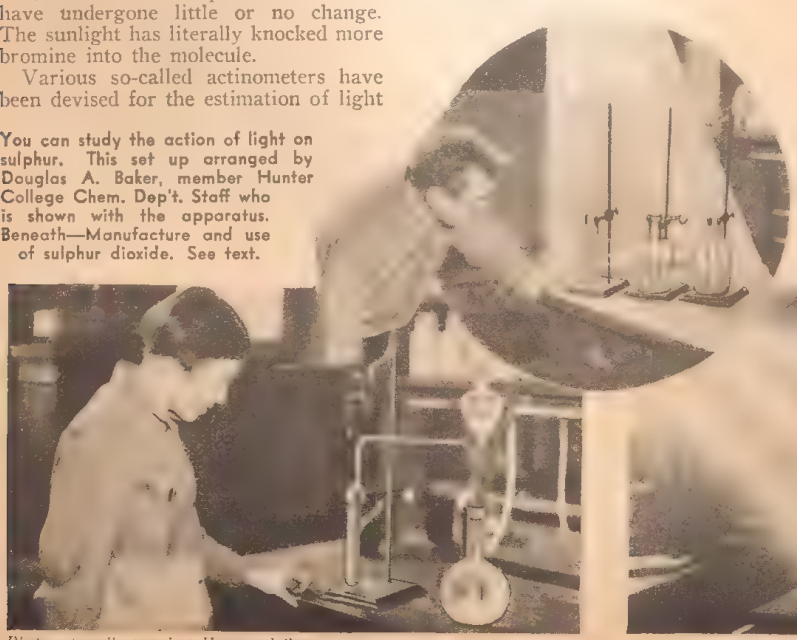
The same solution may also be used to demonstrate photochemical extinction. A small quantity of the above solution is placed in a test-tube inserted within a larger tube also containing the above solution. On exposure to light the solution in the outside tube becomes opalescent while the inner solution remains clear. This experiment serves to show that photochemical decomposition implies absorption of the chemically active rays.

The action of light on sulphur is the basis of a very instructive experiment. Place a small quantity of a solution of sulphur, which has been dissolved in carbon disulphide, in each of three test-tubes loosely stoppered. Place one of the tubes in a beaker of copper sulphate solution, place a second in a beaker of potassium bichromate solution. Expose all three tubes to direct sunlight. After standing for a while in the light, sulphur separates in the tube unprotected by a colored solution and in the one protected by copper sulphate solution. No precipitation of amorphous sulphur takes place in the tube surrounded by the beaker of potassium bichromate, showing that the violet light is mainly responsible for the action taking place as potassium bichromate solution is an efficient violet light filter.

White phosphorus changes into the red allotropic variety under the action of sunlight. Expose a small piece of phosphorus under water in a test-tube to sunlight. In several hours a red coating on the phosphorus will be apparent.

When chlorine gas is dissolved in water some of it reacts with the latter to form hypochlorous and hydrochloric

(*Continued on page* 1132)



You can study the action of light on sulphur. This set up arranged by Douglas A. Baker, member Hunter College Chem. Dep't. Staff who is shown with the apparatus. Beneath—Manufacture and use of sulphur dioxide. See text.

Radiant energy can be transformed into electrical power.

Photos specially posed at Hunter College

Strong Man Tricks Which You Can Do

The Vaudeville Strong Man Excites Imagination, Arouses Envy, Holds Our Interest, and Amazes Us by the Spectacular Exhibitions Which Make Up His Act. He Puts on a Good Show—But So Can You!

By Seymour A. Davidson

UNUSUAL muscular development is not essential to the successful performance of the majority of the strong man tricks. The big-muscle man who struts about on our vaudeville stage, flexes his biceps, and assumes striking poses to display his Herculean proportions to better advantage does not often depend upon physical power for the completion of the amazing and spectacular exhibitions which he undertakes. He frequently relies upon technique, knack, and the knowledge that certain parts of the body, especially the long bones, can withstand severe strain and pressure.

Do not assume that these statements are intended to disparage the genuine strong man. On the contrary—there is one qualification that you must possess in order to imitate his demonstrations—that is, *strength*. Only one type of person can successfully compete with the real strong man and that individual is another *genuine strong man*.

With a slight amount of slack, a tight grip on a rope, and his chin pressed against the knot, this gob effectively prevents a dozen seamen from strangling him. Try this stunt with a rope tied around your chest and see how easy it is.

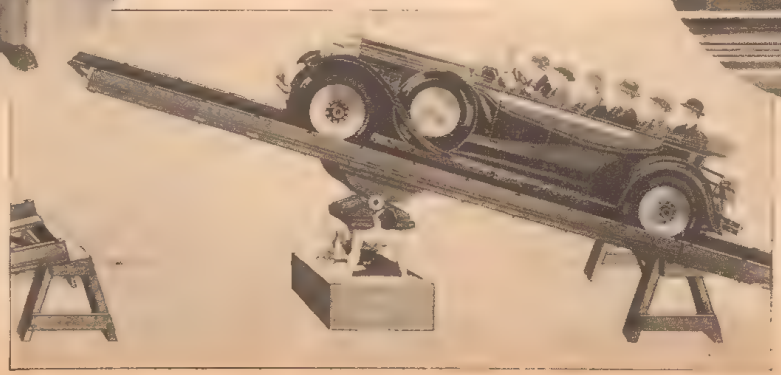
You, however, can duplicate practically all the sensational tricks which the average vaudeville performer considers his stock in trade. It is not a question of being able—it is merely knowing how. Follow the suggested effects and you will be able to impress your friends and even critical audiences.

Let's enter a theatre and see just what is going on. . . . The spotlight shoots down like a white arrow to the center of the stage. There stands the strong man, clad in his traditional leopard skin tights. The bulging muscles of his stocky, well formed body, give him the appearance of a man about whom is twined an endless twisting serpent. He holds a full size red brick.

An air of hushed expectancy can be felt all over the theatre. The strong man has announced that he will break, with his bare hands, this solid, substantial building material, designed to support enormous pressure. His hands may be unusually tough but they are, after all, only flesh and blood and even when clenched, comparatively soft and yielding.

The brick is genuine—Several members of the audience who have just returned from the stage can testify to that. They examined the brick and even tried to break it. And how helpful the strong man was! He tried to show them how to hold the brick and explained that one end must be held firmly against a solid surface at an angle of 45 degrees. Every encouragement was given their clumsy maneuvers, but it was of no use. The audience could see that plainly. Pityingly, the strong man

Wrap a towel around an iron bar. Tilt your head back and lock it in position. Now pull with both hands. You can finish the bend by the method described in the text.



The enormous momentum gained by the downward sweep of your arm will enable you to drive a nail through even a heavy plank. Left—A spectacular demonstration given by Lionel Strongfort at the New York Hippodrome.

On a level road a steady tension will start even a heavy vehicle. After that it is easy to keep it moving. Of course, an imperceptible down-grade helps.

praised their futile attempts and cautioned them on the care of their bruised knuckles.

And now this man of flesh is about to attempt the conquest of stone. He stoops in the full glare of the spotlight. To the accompaniment of a fanfare of trumpets and the roll of drums his hand strikes the brick sharply. It breaks in half!

How does he do it? The brick is held a slight distance away from, rather than tightly against some solid base. When struck it hits that base and the impact breaks the brick. A tremendous feat of "strength" has been performed, which you will find comparatively easy to duplicate.

Before we delve into the more detailed tricks with which the strong man is accustomed to hold wonder-eyed audiences spellbound, let us examine some of his stunts which you can perform in your parlor, or at a party. No preparation is required and very little, if any, paraphernalia is needed. Yet these astonishing demonstrations will mystify and astound those who are not familiar with the showman's tactics.

At a gathering you can amaze your friends by proving that after you bend your arms so as to touch the fingers of each hand together in front of your chest, none of them can force your hands apart.

Show them that your fingers cannot be separated unless you permit it. In fact, if this stunt is done correctly, a child can resist the efforts of an adult and a powerful man finds his strength of no avail when exerted against a relatively weak individual. Baffling as this demonstration may seem, it is merely the practical application of well known but not easily recognized physical principles. Here's the way it's done. Hold your hands in front of your chest, fingers extended. Bring them together until they meet. In this position, fingers, hands and forearms, form one continuous straight line. Your victim stands directly in front and facing you. His left hand grasps your right wrist. His right hand is on your left wrist.

Ask him to separate your hands. Note the look of surprise and consternation that will spread over his face when he finds that he cannot budge your finger-tips.

The secret of your success lies in the fact that you are far better situated to resist a pull than your co-worker. If you are asked to play the active rôle, you can easily separate the other person's hands by moving to one side and exerting a push and pull effect, keeping one arm bent and the other straight.

A very effective feat which is some-

The weight of the upper part of the body is equally divided on the closely placed nails. You can plainly see that a good deal of the load is being supported by the strong-man's legs, requiring no muscular exertion on his part. The shock of the hammer blows is absorbed by the bulk of the anvil.

Charles Atlas as he is today after developing himself from a weakling to the "World's Most Perfectly Developed Man"!

MR. ATLAS says:
"A real, genuine strong man is not one who by trickery can apparently lift an enormous weight, or permit a loaded wagon to pass over him. The real, genuine strong man can do the following without stopping: 700 sit-ups from a lying-on-the-floor position, 500 push-ups from the floor with body outstretched, 500 kneebends from standing to a squatting position, and 200 raisings up on the toes. I have often done all these in a little more than an hour's time, without strain. This is a true test of strength."

Hold the book loosely and bring the ends together so as to form a deep bow in the middle.

Tighten your grip and straighten the book out at the same time. In all the phone book tearing tricks, the stunts are most easily accomplished if the covers are discarded. Throw them away as if they did not matter.

Extreme left. Driving a nail straight from the shoulder. If you put the sharp end of a nail into a gas pipe, you can easily bend it. Of course, you must pad the head.

Right — This is the way thick bars of iron can be bent. The distorted bars are then handed to members of the audience who are asked to straighten them.

Extreme left. He seems to find it no very great task to curl iron bars around his arm. Yet he cannot force this petite young lady's finger tips apart.

Right — Make sure that you hold the brick some distance away from the floor when you do this. Extreme right—Your hands must be as close to each other as you can get them.

what similar to the stunt just described is as astonishing as it is simple. Place your palm firmly on top of your head. Now you can safely defy anyone to lift your hand away from your head.

At first glance it seems impossible for you to maintain this position if opposed by a sturdy individual. No doubt several people will attempt to show you up. Although you will impress them as a second Samson by your success, you know that they will fail, because in this position the energy which they expend merely pushes your body from one side to another and very little of it is actually applied to the lift.

Two things to remember: Fan the leaves of the book and then maintain a tight grip until you have separated the two halves of the book.

Put the book on your knee, apply equal pressure with both hands. The binding must break. Then tear the pages.

Five fragile fingers can lift a person. Just five unaided digits will support even a heavy individual and hold him suspended in the air. "Marvelous," you say. And there is no trick to this. As stated before—it's merely a matter of knowing how.

Ask your subject to stand in the center of the floor where he can be plainly seen. Now, have an assistant place his index finger under the subject's chin. A second puts his index finger under the left instep, a third under the right instep, a fourth and fifth under each armpit. At your command, they simultaneously lift. Five fragile unaided fingers raise a man. The weight being divided, each person lifts about 30 pounds or more.

How strong are you? Are you as powerful as the average man of your height and weight? Are you as strong as four men? You are! Four husky individuals, each one more rugged than you, all working together as a perfect team, cannot break your grip. What could be funnier than four heavyweights struggling with might and main, red faced and panting, because of their exertions, while their sole opponent stands calm and unperturbed, secure and undisturbed, because he alone knows the secret.

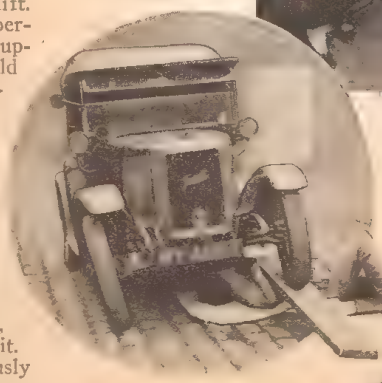
Here's the way it's done. Make a circle about 8″ in diameter by knotting a piece of heavy rope; grip the circle at opposite points with both hands. One man stands at your left side and locks his hands around your elbow joint. A second holds him about the waist. The third and fourth men station themselves similarly at your right side. When you give the signal they tug. After about ten minutes of useless effort on their part, you can tell your crestfallen and worn-out friends that better men than they have tried—and failed.

Included in every strong man's bag of tricks is the iron bar bending stunt. It is an impressive act and the watching crowd always accept the ease with which the vaudeville man curls the metal rods as certain evidence of his marvelous muscular power. Here again the man on the stage relies on his head rather than on his hands. You, too, can startle audiences with this astounding demonstration. Get several bars about five feet long — half-inch square stock is most suitable for a beginner. Hand them out to the crowd and ask a number of persons to examine them. When they are returned to you, put your left foot forward and place one end of a bar against your instep.

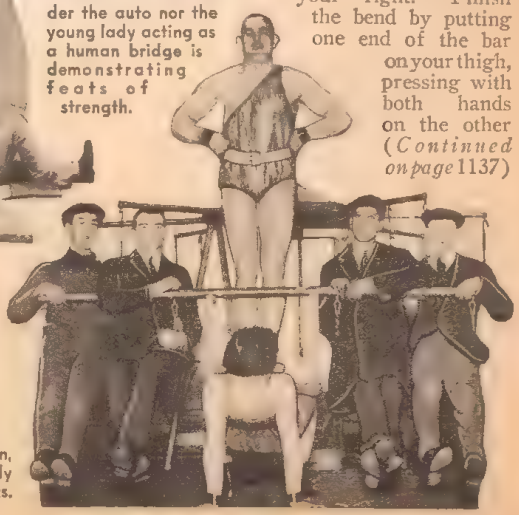
Grasp the bar at its midpoint with your left hand. Your right holds the other end of the bar. Push with the left hand. At the same time lean forward and pull back and downwards with your right. Finish the bend by putting one end of the bar on your thigh, pressing with both hands on the other

(*Continued on page* 1137)

A heavy person can quite easily be raised by a simultaneous lift of five individuals, each using one finger.

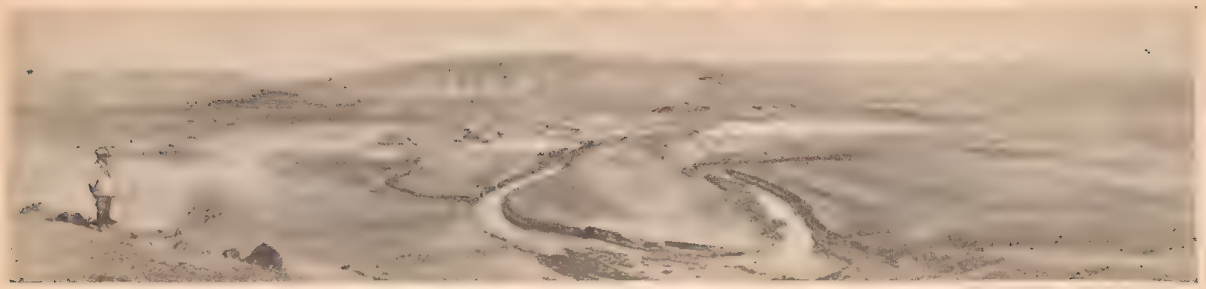


Neither the man under the auto nor the young lady acting as a human bridge is demonstrating feats of strength.



When the wheel first starts up the plank, the end on the ground supports the greatest burden. As the car rises, its center of gravity shifts so that the weight on the man is negligible.

A very impressive demonstration, but the load is distributed entirely upon the long bones of the legs.



A general view of the Jordan in its natural course, flowing below the power plant, which is situated in the center of the picture at the distant end of the left-hand loop of the river.

Power From the Waters of the River Jordan

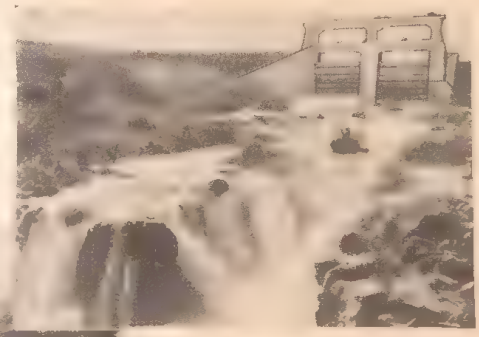
As Part of the Modern Development of Palestine, Engineers are Busily Engaged in Diverting the Waters of the River Jordan so That They May Be Utilized in a Giant Hydro-Electric Plant Which Will Eventually Illuminate the Ancient City of Jerusalem by Electricity

THIS series of photos graphically depicts the work of construction now being carried out on the Rutenberg Jordan electric plant system near Jerusalem, Palestine, which will be the first Jordan River power house. The canal system and the storage reservoir have just been tested out. The building of this power dam is one of the most gigantic projects ever to be attempted in the Holy Land, which called for the arresting and confining of the waters of the Jordan and the Yarmuk rivers within this new lake built by man. When filled to its utmost capacity, the lake will measure four miles long by one mile wide and will contain from three to four million cubic meters of water.

The Jordan, flowing southward and the Yarmuk northward, meet in the Jordan Canal and find a mutual escape through the flood sluices down to the original Jordan bed. Normally, when the Yarmuk reservoir is filled and operating, this condition would only occur in case of heavy floods, to relieve the overflow.

The Jordan Canal, which diverts the historic old river from its time-honored water bed, is nearly two miles long, bringing the Jordan water into the Yarmuk reservoir, thus unveiling the rounded pebbles of the Jordan bed for the first time since the Israelites crossed on dry ground some 3,400 years ago.

The turbines are known as the Francis inward flow type, representing 8,000 horsepower each. At the transformer station close by, the voltage will be stepped up from 6,600 to 66,000 volts for distant transmission to all parts of northern Palestine. This first power station will have a capacity of fifty million kilowatt hours per year.



Above — The Niagara of the Holy Land. The river Yarmuk in its natural course below the Yarmuk Dam, which is seen in the immediate background. Left—A general view of the Jordan Canal, diverting the water from its old course to the storage basin.

Above — Arab and Jewish laborers, former enemies, toiling side by side, enlarging the tailrace canal below the power house. Left—A panorama of Rutenberg's Jordan electric plant system.

Radio Equipped Toy Balloons To Aid Aviators

Not All the Studies Concerning Weather Are Done by the Weather Bureau. The Signal Corps has Its Own Stations Operated Largely to Help Army Fliers

By Walter Raleigh

IN the United States the Signal Corps of the Army was the first public unit of Uncle Sam's to study the weather. The first meteorological section was established in 1880. When the demand from private interests for weather information became so great as to pass the facilities of the Army, the division was taken from Army control and turned over to the Department of Agriculture.

However, at the outbreak of the World War, Army authorities realized a need for military meteorology and the Signal Corps reorganized to study the weather. Since the war the work has been continued at Fort Monmouth, New Jersey, where large numbers of students are trained in this work. There are now thousands of observation posts scattered all over the United States.

Temperature is probably the most familiar of the weather elements. The mercury-bulb such as is used in the ordinary home is brought to a state of the utmost precision. Another type, actuated by the effect of heat on metal, connected with a pen resting on a graph, and known as a thermograph, has been used by the Army weather bureau.

The other instruments, such as the barometer, are also used. A rising barometer indicates fair, cool and dry weather, and a falling barometer forecasts foul weather to come. Wind vanes are also used.

At Fort Monmouth wind information is recorded electrically on an instrument known as a quadruple register, a complicated device which keeps a permanent record of wind direction, wind velocity, amount of rainfall and amount of sunshine.

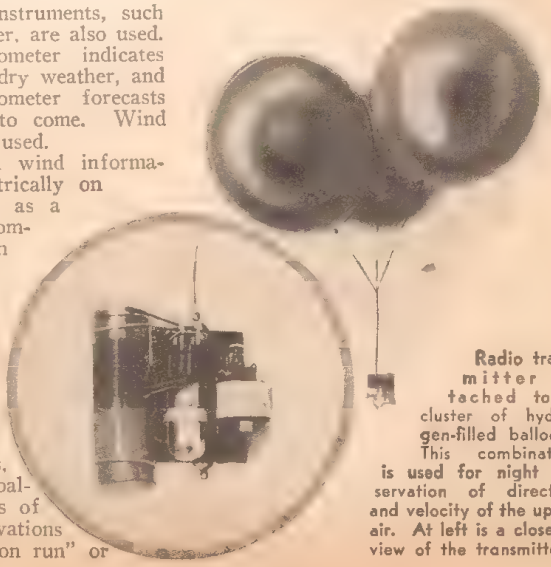
For wind data at higher altitudes, knowledge of which is necessary to aviators, the army uses toy balloons, and the process of making these observations is known as a "balloon run" or "balloon sounding." Rubber balloons of a known weight and size are filled with hydrogen gas. They are released and the speed and direction of their flight are noted with an instrument similar to a surveyor's transit, or theodolite. The rate of rise of these balloons per minute is known, and from this, coupled with the observations made through the theodolite, the wind variations are determined and plotted.

While the balloon run is being made, the observer at the theodolite is in telephonic (*Continued on page* 1139)

Colonel A. S. Cowan, commanding officer at Fort Monmouth, N. J., supervising the making of observations by members of the Signal Corps. The balloon is sent aloft and its course followed by means of the theodolite shown at the left. The direction and velocity of the wind at any height up to 100,000 feet are thus accurately determined.

The time interval apparatus (right) which is used with the theodolite in making visual wind observations. The soldier is plotting the course of the hydrogen-filled balloon from readings telephoned to him by the theodolite operator.

Technical Sergt. O. W. Palmer operating the radio compass which is used to follow the course of the balloon cluster and radio transmitter.



Radio transmitter attached to a cluster of hydrogen-filled balloons. This combination is used for night observation of direction and velocity of the upper air. At left is a close-up view of the transmitter.

My Wireless Memories and

The Author of This Extremely Interesting Article Has, in a Half Century of Active Professional Work, Probably Seen More of the Stirring Modern Development and Practical Application of Electrical Engineering and Radio Communication Than Any Living Man, with the Exception of Edison. Although He Is in His Eighty-Second Year, Sir Ambrose Still Retains a Remarkably Brilliant Memory

I HAVE been asked by the Editor of SCIENCE AND INVENTION to give his readers some historical account of my connection with wireless invention and especially with long distance wireless telegraphy, which is the marvel of this century.

To do that I shall have to go a long way back in point of time to the days when, from 1877 to 1880, I was an undergraduate in the University of Cambridge, England, and enjoyed the privilege of the personal teaching and intercourse with one of the greatest scientific investigators of the nineteenth century, namely James Clerk Maxwell, then Cavendish Professor of Physics in the University of Cambridge. He himself was a disciple of Faraday and, convinced of the fundamental correctness of Faraday's views that the source of electrical phenomena must be sought in the physical state of the medium or dielectric, and not in the action-at-a-distance theory of surface charges on conductors, he set himself prior to 1865 to translate these ideas into mathematical language.

Michael Faraday depicted with the helix with which he discovered the production of an electric current by a magnet.

The outcome of his work was the establishmeent of two mathematical expressions called Maxwell's equations. Faraday showed that if a magnet is moved towards a sheet of metal or conducting plate it creates in it an induced electric current. Maxwell initiated the idea that if the plate is what we call a non-conductor, such as glass or ebonite, though the moving magnet cannot then create a current it creates a state which Maxwell called an electric displacement, which, whilst it is either increasing or diminishing, is equivalent to a current.

From these equations he obtained another, which proved that an electric displacement produced at one place is not felt everywhere in surrounding space at once, but is propagated outwards with a velocity which Maxwell showed must be that of light.

Then, in 1865, there was published by the Royal Society of England a paper containing these investigations entitled "A Dynamical Theory of the Electromagnetic Field."

In this epoch-making paper Maxwell expounded his theory of electromagnetic waves and showed that light consisted of such waves. After Maxwell's early and deeply lamented death in November 1879, an eminent Cambridge mathematician said to me that he considered this paper one of the greatest productions of the human mind.

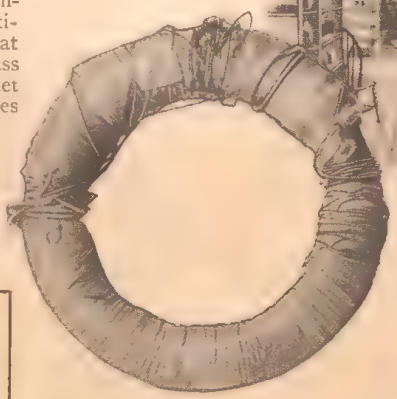
Heinrich R. Hertz, who was the first to produce and detect Maxwell's electromagnetic waves.

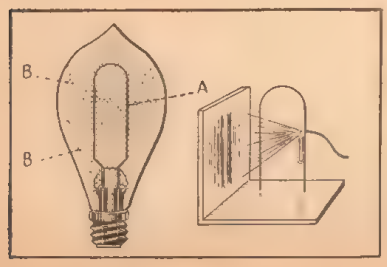
Maxwell lectured at the Cavendish Laboratory each year on Electricity. But he was not easy to follow and not suited to the average student. To those, however, who could follow him, he was an inspiration. I diligently attended his lectures together with an American gentleman, whose name I think was Middleton, and we two formed his only class for one whole session.

Once, when Maxwell had given to us a splendidly original lecture, Mr. Middleton turned to me at the end and said: "Sir! this man (Maxwell) is great! He does not come down here and tell us what he has read out of books, but gives it to us hot from his brain."

Anyway, I imbibed from Maxwell some faint notions of his celebrated theory of electromagnetic waves and was stimulated to try to know more of them. His death deprived Cambridge of one of its greatest investigators and teachers, and eight years elapsed before any experimental advance was made. Meanwhile I had become connected as scientific adviser with the Edison Telephone Company of London. Alexander Graham Bell had given us, in 1877, the magneto telephone receiver and Edison also the carbon button transmitter, and the two London companies owning these inventions were engaged in litigation with each other. Presently they had to join forces to fight the British Government, who claimed under the Telegraph Acts of 1868 and '69 that a telephone was a telegraph within the meaning of these Acts, and that tele-

Right — The laboratories of the Royal Institution, London, the birthplace of the greatest discoveries of Davy, Faraday, Tyndall, and Dewar.





Above—The iron ring wound over with two insulated wires with which Faraday made the discovery of induced currents. Left — An Edison carbon filament lamp blackened by carbon deposit, but with a white line of no deposit on the plane of the filament, also a model for demonstrating the effect.

Inventions

By

Sir Ambrose Fleming, F.R.S.

Emeritus Professor of Electrical Engineering in the University of London

Sir Ambrose Fleming, F.R.S., photographed with some of the early Fleming Valves for which he is chiefly world famous. These valves are the prototypes of all modern radio tubes.

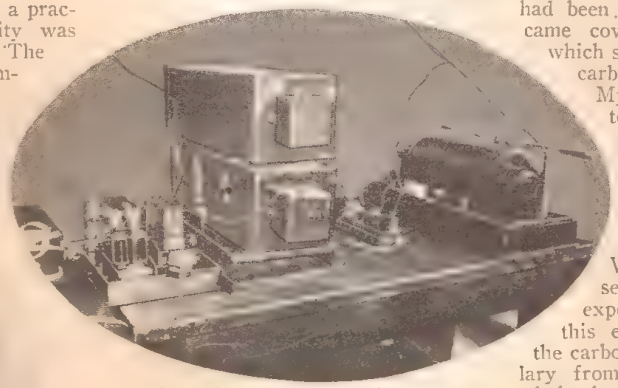
phone exchanges could not be worked without a license from the General Post Office. This gave rise to a famous legal action in which both sides retained scientific men as experts. I am at present the only survivor of all the dozen men so retained.

In the same year (1879) Edison patented in Great Britain his carbon filament incandescent lamp, and Swan had also perfected his carbonised thread lamp. Two years later the Crystal Palace Electrical Exhibition was held and incandescent electric lighting as a practical and commercial possibility was demonstrated in Great Britain. The Edison Electric Lighting Company of London was formed to exploit Edison's system, and I was appointed in 1882 as its scientific adviser in conjunction with the late Dr. John Hopkinson. It will be seen presently that my appointment had as one outcome the invention of the Thermionic Valve twelve years later.

James Clerk Maxwell, who proved theoretically the existence of electromagnetic waves now used for radio communication.

After taking my degree at Cambridge in 1880, I was appointed lecturer on Applied Mechanics, and during that time I designed a special form of Wheatstone Bridge for comparing the resistance of the standard coils made by the British Association to represent the Ohm. This work I had begun at Maxwell's suggestion. For a short time I held the position of Professor of Mathematics and Physics at University College, Nottingham, before removing to London to take up my post with the Edison Electric Light Company. In 1882 I was elected a Fellow of my College (St. John's College, Cambridge), and I was lately elected an Honorary Fellow of this Society.

Edison had by that time (1882) given us his incandescent electric lamp with a filament of carbonized bamboo. He had also worked out all the details of a public electric supply station with the lamps arranged in parallel on the mains. It was found very soon that the interior surface of the exhausted glass bulb of the lamp, when the latter had been in operation some time, became covered with a black deposit which seemed to be due to volatilized carbon.



Marconi's wireless telegraphy apparatus as arranged and used by him in September, 1899, in the Dover Town Hall for a lecture before the British Association by Sir Ambrose Fleming. The transmitter employed a 10-inch spark coil. The receiver employed a coherer as detector and a Morse inker.

My attention was soon drawn to a curious fact, namely, that in some cases there was a sharply marked white line of no deposit on the bulb, which was always in the plane of the horseshoe-shaped bamboo filament.

When I followed up this observation, carrying out some experiments, it became clear that this effect was produced because the carbon was not thrown off irregularly from the filament surface as a whole, but only from one special spot which must have become overheated by some defect in the filament. Moreover, this line of no deposit proved that the carbon particles were in that case thrown off in straight lines. I called this effect a "Molecular Shadow" and read two papers on it before the Physical Society in 1883 and 1885.

About that time Edison had sealed into the bulb of one of his lamps a metal plate, (*Continued on page* 1125)

Above — The building erected at Poldhu, Cornwall, England, to house the transmitting plant, and the aerial which radiated the first transatlantic wireless signal, the famous letter "S". Right — The first high-power transmitting plant arranged at Poldhu in 1901 by Sir Ambrose Fleming. Two transformers, left; condenser boxes in rear racks.

Overhauling Your Outboard Motor

Now That Good Weather Is Approaching It Is Time to Think About Putting Your Outboard Motor in Proper Shape, Ready for the Coming Season. This Article Gives You Complete Information as to What to Do, and How

By J. Phillips Dykes

Vice Commodore and Secretary, American Outboard Ass'n.

Jack Kerr, Harrison Fraser and Malcolm Pope using the compression tester described in the article.

THOUGHTS of Spring will immediately remind you that your outboard motor is out in the boathouse, or garage, or wherever you keep it, waiting to be overhauled before taking you on many a ride during the coming summer months.

"Provided you put it away in good shape, you won't have much trouble in getting it to run. However, there are a few important things you should do before running the motor, and here they are."

First, place your motor on a stand, clamp it securely in place with the thumb screws and, using a few old rags and a pail of gasolene, kerosene or the old oil and gas left in the tank, wash the entire outside thoroughly so that there will be no grit or dirt to get inside when you open up the works!

Now remove the three screws in the starting plate on top of the fly wheel, take off the nut and lock washer from the end of the crank shaft, and lift off the fly wheel. If it comes hard, lift the motor by the rim of the fly wheel and strike the end of the shaft a hard tap with a machinist's hammer. This will force the tapered end of the shaft out of the fly wheel hub and your magneto will then be exposed.

Clean all sand or other dirt from the inside of the magneto. Then, with some fine emery paper or a thin flat file, remove all dirt and corrosion from the breaker points of the breaker assembly, being mighty careful never to turn the nut on the upper breaker point as this will throw the motor completely out of timing and give no end of trouble. Now inspect all wiring for exposed or worn places, replacing if necessary. Place a few drops of Three-in-One oil on the tapered end of the crank shaft, apply a small amount of grease to the bearing surface of the armature plate hub, and replace the magneto and fly wheel, being sure to tighten the nut over the lock washer so that it will not work loose when in use. This is all you can do to the magneto.

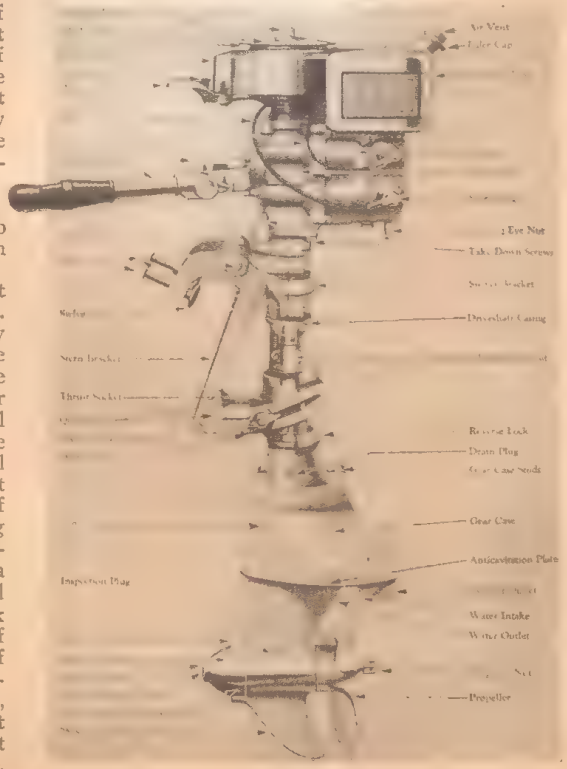
With the starting plate off, you will see a small opening in the top of the fly wheel. Turn the fly wheel until the breaker points are directly under this hole and in plain sight. Take your magneto wrench (Fig. 1) and move the fly wheel until a deep filed notch in the bottom rim of the fly wheel is directly in line with a corresponding notch in the armature plate. The pistons are then at top dead center. Now open the little wafer-like blade in the handle of the magneto wrench. This blade is just 25/1000ths of an inch thick and represents the amount of clearance you should have between breaker points if you turn the fly wheel until the points separate. If the clearance is not right, loosen the two screws on the base of the breaker assembly and move slightly until the proper clearance is shown. When you have done this your motor will be timed just right and that most important job will be done.

Now test your motor for loss of compression, using the gauge described later in this article. If you find low or unequal compression it is well to remove the power head by taking out the four screws on the under side, disconnect all pipe lines, take off the rotary valve and carburetor, and wash everything clean with coal oil. Piston rings are only 25 cents each and are mighty cheap insurance, so if there seems to be the slightest reason to do so, replace them at once. And it might be pertinent to state here that many cases of lost compression are due to frozen rings.

In removing old rings, be careful not to nick the ring grooves with your screw driver. It will not be necessary to fit the new rings as they are factory fitted and will slide right into their grooves when properly placed. Here is an easy way to place them.

Take three strips of thin sheet metal the thickness of the magneto timing gauge (25-1000ths). They should be 2 inches long by ½ inch wide. Place them flatly against the sides of the piston so that they stick up a half inch above the end of the piston as in Fig. 2.

Holding the metal strips firmly against the sides of the piston with the fingers of the right hand, place the first ring over the three metal strips and then gently work the ring down over the piston until it is directly over the bottom groove. Do this with the other rings until they are in place, held by their (*Continued on page* 1149)



Drawing of an outboard motor, with all its component parts indicated.

An interior view of the Rosenthal High-Voltage Testing Laboratory, in Selb, Bavaria. Electrodes of the alternating current apparatus are seen in the foreground. Toward the rear, at the right, is the DC installation.

Playing with 2,000,000 Volts

Practical Engineers Are Now Working With Super High Potential Circuits at Voltages of Over 2,000,00 Volts

By Robert Cordes

Workers setting one of the huge copper electrodes in place.

A SUDDEN, spurting, blinding, flaring, flaming flash—a terrific ear-splitting, cannon-like report reverberating from wall to wall—the pungent odor of irritating ozone—a potential of two million volts has leaped across the spark-gap!

Observers stationed safely and securely high up along the side walls of the building in specially constructed perches busily jot down notes. The floor beneath them is a scene of intense activity. . . . Workers hurriedly remove materials and replace them just as swiftly. At a signal the floor is cleared. To the casual glance the immense, high-vaulted, wide room has been emptied. All is in readiness for another discharge.

What is the meaning of all this? Of what use is this new powerful high-voltage apparatus? Why has it been installed? What will it accomplish? How is it being used? What practical purpose will it serve?

It is a matter of common knowledge that because of the extent of our modern developments electric power must often be transmitted at potentials as high as two hundred thousand volts. And if the expectations of those who are familiar with the problem are realized, this figure will soon be raised to three hundred and eighty thousand. The cables which carry this very high potential can be tested only by a break-down voltage of over one million volts. The insulators to which these conductors are fixed must also undergo this test before being approved.

Testing glass insulators, the glass is chilled to —98° C. and then dipped into boiling water. Below—An insulator under breakdown test.

Necessity here was not only the mother of invention but the broodmare of this high voltage proving ground—the largest and best provided station of its kind. Although the builders drew freely upon the experiences gleaned from recent years, they also exercised their own ingenuity, always bearing in mind the purpose of the installation and the practical requirements. As almost all the experiments must be performed in absolute darkness to insure the observation of even the most minute flashes, the building is windowless to prevent the entrance of outside light.

The vast experimental room measures about seventy by ninety feet in area and the ceiling is almost seventy feet from the floor. These large dimensions preclude the possibility of arc-discharges of current from the apparatus to the walls. Two complete, separate and independent installations are maintained. One comprises the alternating current instruments and the other is the direct current circuit, which has enabled technicians to make great advances in the study of current leakage across insulators. In addition, a high frequency system, which is at present being used in the old testing station, has been adapted to permit the production of a potential of over two million volts. It is possible with the new apparatus to reproduce freak conditions which have never before been attempted in a (*Continued on page* 1132)

Penetrating the Atom with Beta- and Gamma-Rays

With the New 2,000,000-Volt Apparatus Emanations Similar to Those Emitted by Radioactive Substances Can Be Produced

By O. W. Torreson

Department of Research in Terrestrial Magnetism, Carnegie Institute of Washington

ATOMS used to be thought of as the smallest subdivisions of matter until it became recognized that they actually are complicated systems of much smaller units. It is now well known that the different kinds of atoms which make up the ninety-odd elements of which all material things consist, are made up of different numbers of electrons surrounding a core, very heavy in comparison with the electrons, which is called the atomic nucleus. Much has been learned in recent years about the electrons which surround the nucleus, from studies of spectrum-lines and from other types of investigations, but comparatively little is known about the nucleus itself. The nucleus is such a tightly-bound unit as almost to defy investigation and yet a better understanding of its structure and of its internal behavior is necessary and fundamental to our more complete knowledge of matter and of radiation.

The eighth annual award of the American Association for the Advancement of Science, for a noteworthy contribution to science, was given at the last meeting in Cleveland, Ohio, in December, 1930, to M. A. Tuve, L. R. Hafstad, and O. Dahl, of the staff of the Department of Terrestrial Magnetism, Carnegie Institution of Washington, for their achievement in producing with laboratory apparatus, rays similar to the beta- and gamma-rays emitted naturally from radium and other radioactive substances. These investigations, begun several years ago, have been carried out at the laboratory of the Department of Terrestrial Magnetism, in Washington, D.C., and are being continued by that Department in its program of research in atomic physics to determine fundamental laws of importance in the solution of its problems in terrestrial magnetism and electricity.

Fig. 1 — Sectional high-voltage vacuum tube with copper electrodes in position within the tube.

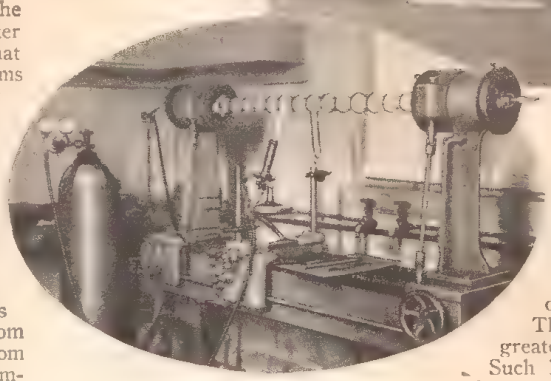


Fig. 2—Glass-blowing lathe with which vacuum-tubes are made and heat-treated to withstand high voltages.

The ultimate purpose of the work has been, and is, the investigation of the innermost structure of the atom, the production of the beta- and gamma-rays being incidental to the major purpose. Although incidental, the production of these rays has been an important step in the development of the project, for the apparatus which has been used has thereby been demonstrated to be a tool with which at least a beginning can be made on the fundamental problem.

The problem is, then, of the greatest significance.

Such knowledge of the atomic nucleus as does now exist has been derived almost entirely from investigations made with radium and other radioactive substances. These substances emit alpha-rays as well as the beta- and gamma-rays which have already been mentioned. The alpha-rays are the nuclei of helium atoms shot out with high velocities, the beta-rays are electrons with high velocities, and the gamma-rays are very penetrating X-rays. The alpha- and beta-rays are electrically charged particles whereas the gamma-rays are electromagnetic waves which have velocities identical with that of light. All three types of rays have enormous energies when emitted. The alpha- and beta-ray energies are revealed by their velocities, these velocities (or energies) being as great as would be acquired if the particles were accelerated from a state of rest by electric potentials ranging in magnitude from one hundred thousand to several million volts. The gamma-ray energies are of the same order of magnitude but these energies are revealed not by velocities but by the penetrating-power of the rays.

With such knowledge of the character and the energies of the three different types of rays, it was possible to plan for and gradually to develop an apparatus which would furnish electric potentials up to millions of volts with which to accelerate electrons to obtain beta-rays

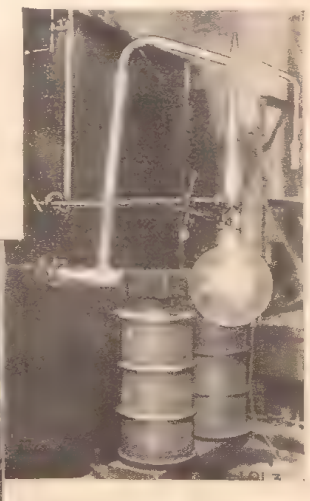


Fig. 3 — Primary and secondary coils of Tesla transformer. In the background are the by-pass condensers which protect the secondary-coil windings.

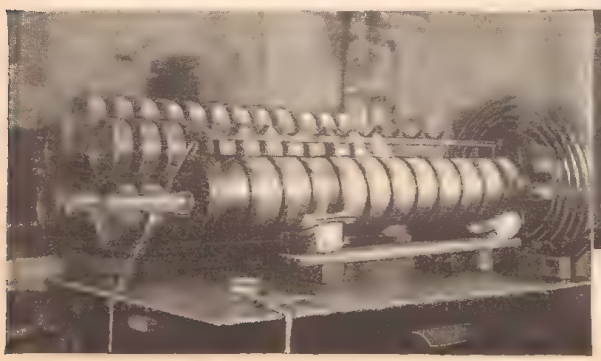


Fig. 4—Magnetic-deflection apparatus for the study of beta-rays, mounted at the end of oil tank.

and then, with the accelerated particles, to obtain gamma-rays from a target introduced in the path of the particles.

The development of an apparatus which withstands successfully the application of nearly two million volts has been in itself no small achievement. This apparatus consists essentially of a Tesla transformer, a glass high-voltage tube of several sections, an oil tank, and measuring apparatus for studying and recording the rays or their effects. The sectional high-voltage tube is shown in Figure 1, with the electrodes, in place within the tube, to which connections are made from the segments of the secondary coil of the Tesla transformer for beta-ray investigation. In Figure 2 is shown the glass-blowing lathe with which the high-voltage tubes are made. Straight lengths of drawn pyrex tubing are heated, section by section, over their entire length and molded into the desired shape. Recently developed methods of heating and molding the tubes have eliminated shattering and puncturing difficulties which were frequently encountered earlier in the work. In Figure 3 are shown the pri-

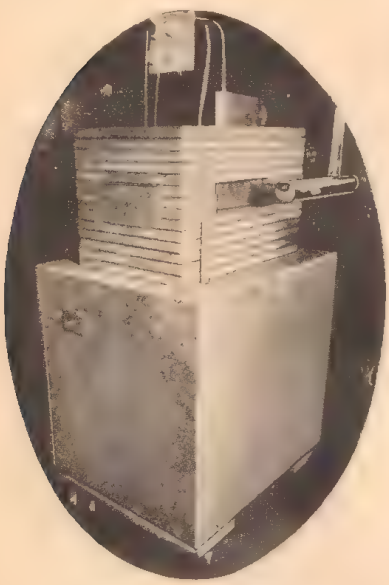


Fig. 7—Lead block enclosing Geiger-Muller counter.

mary and secondary coils of the Tesla transformer and in the background, the arrangement of by-pass condensers which are placed around the secondary coil to protect the insulation of the latter. In this figure the high-voltage tube is in place within the secondary coil. After assembly, the tube, Tesla transformer, and the shields are suspended in the oil tank in transformer-oil, the end of the high-voltage tube projecting through one end of the tank and connecting with a vacuum-pump and with the measuring or recording apparatus. Figure 4 shows the recording-apparatus mounted outside the end of the oil tank for the study of beta-rays.

In this figure the large glass bulb shown is connected directly to the end of the high-voltage tube, the connecting tube passing between the poles of the magnet. The electrons, emitted from a hot filament at the inner end of the tube, are there influenced by the high voltage, and they travel through the length of the tube with high velocity. If the field of the magnet is zero, the high-speed electrons or beta-rays remain undeflected and affect a certain

MEASUREMENTS WITH GEIGER-MULLER COUNTER

GAMMA-RAYS FROM HIGH-VOLTAGE TUBES AND GAMMA-RAYS FROM RADIUM SHOW THE SAME PENETRATING POWER THROUGH ONE-, TWO- AND THREE-INCH THICKNESSES OF LEAD.

THICKNESS OF LEAD	RAYS FROM HIGH-VOLTAGE TUBE (1)		RAYS FROM RADIUM	
INCHES	NO PER MINUTE	%	NO PER MIN	%
	282	100	89	100
2	82	29	26	29
3	24	9	9	10
ABSORPTION COEFFICIENT	0 48		0 48	

(1) Tube operated at rate of one spark per second.

THE EFFECT OF GAMMA-RAYS FROM HIGH-VOLTAGE TUBES ON A PHOTOGRAPHIC FILM

THE SECTION ON THE LEFT WAS COVERED BY 1/8 INCH OF LEAD, THE CENTRAL SECTION BY 1/4 INCH AND THE RIGHT-HAND SECTION BY 3/8 INCH. THE VOLTAGE PRODUCED BY THE TESLA COIL IS INTERMITTENT. THE TOTAL TIME THE HIGH-VOLTAGE WAS ON THE TUBE FOR MAKING THIS EXPOSURE WAS MUCH LESS THAN ONE SECOND

CURVES REPRESENTING THE DISTRIBUTION OF GAMMA-RAYS PRODUCED BY NATURAL SOURCES AND BY HIGH-VOLTAGE TUBES ARE SIMILAR TO THOSE SHOWN ON THE BETA-RAY TRANSPARENCY

Fig. 8—Some results from gamma-ray measurements.

portion of a photographic plate which is suspended in the large glass bulb. If the circuit of the electromagnet is closed, however, the beta-rays are deflected to an extent depending upon their velocity and upon the strength of the field of the magnet. When the field-strength of the magnet is known it is possible to deduce from the deflections the velocities or energies of the rays.

Figure 5 shows the effect produced on four photographic plates by deflected beta-rays. The places at which the rays would have struck the plates if undeflected are indicated as the "slit" or "zero-positions." The white areas on the records are the portions affected by the deflected rays. On plate 12 in this figure there is a record from rays produced by a tube-voltage of 1,300,000 volts.

Figure 6 shows the shielded high-voltage tube and Tesla transformer mounted in the oil tank for the gamma-ray investigations. In this arrangement, the shields are each separately connected to one of the electrodes within the tube. In Figure 7 is shown the measuring apparatus used in the study of the gamma-rays, mounted at the end of the oil tank. The end of the high-voltage tube is shown projecting from the tank. Within this portion of the

Fig. 6—Shielded high-voltage tube with Tesla transformer arranged for the study of gamma-rays, mounted in oil tank.

tube is located the target which, when struck by the beta-rays, emits the gamma-rays. Beside the tube is the lead block, built up of one-inch sheets of lead, which encloses the measuring apparatus, a Geiger-Müller counter. In the window at the side of the block were placed one-, two-, and three-inch thicknesses of lead and the gamma-rays were measured after passing through each thickness. Similar measurements on the natural rays from radium, made under the same conditions, showed that the penetrating-power of the gamma-rays from the tube was the same as that of the gamma-rays from radium. Figure 8 shows a record of some of these measurements.

Since most of the beta- and gamma-rays from radium have voltage equivalents under 1,000,000 volts and nearly all under 2,000,000 volts, beta- and gamma-rays have been artificially produced covering practically the whole radium spectrum. The curves in Figure 5 show the distribution of beta-rays in the radium spectrum up to 2,000,000 volts and the estimated distribution of the same rays from tubes operated up to 1,500,000 volts. Somewhat similar curves apply also to gamma-rays. The extent to which the natural rays from radium have been duplicated by rays produced with high-voltage tubes is thus evident.

In Figure 8 is shown a photographic film which was exposed to gamma-rays from a high-voltage tube, through three different thicknesses of lead. Even with a short exposure-time the film was very considerably affected when screened by one-eighth inch of lead, and noticeably blackened even under three-eighths inch of lead. This and other similar records have verified the expectation that the screening or shielding of lead which is applied to the ordinary commercial X-ray apparatus is not sufficient to stop the very penetrating X-rays produced by the high-voltage apparatus developed in this laboratory. Information such as this has resulted from an investiga-

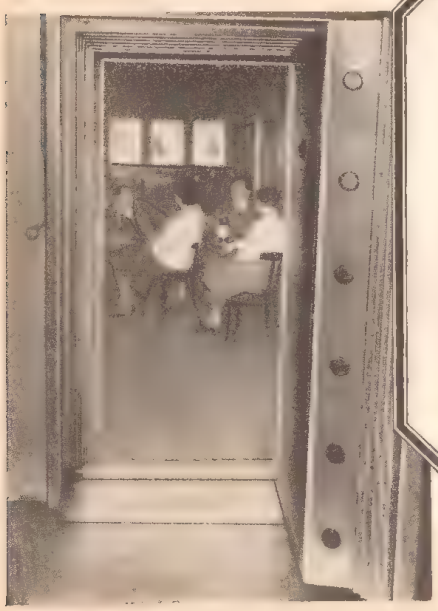
(*Continued on page* 1136)

Would You Believe It?

Sealed in a Casket of Ice

AT the Annual Newspapermen's Club Midnight Frolic, at Portland, Oregon, Mr. A. Moro, the gentleman pictured above, thrilled and bewildered the thousands assembled by demonstrating this unique scientific feat. He allowed himself to be completely surrounded by and frozen into a cake of ice. After half an hour he was chopped free of the ice and was still alive. The photo below shows how the ice casket was made and gives the secret away. His body rests in a large cavity hollowed out of the ice blocks. The end is later sealed.

Bank Vault Becomes Restaurant in Vienna



HOW would you like to eat your meals in the vaults of a bank? The residents of Vienna, who like Russian food, are doing just that. When the Biedermannbank of Vienna closed, a Russian restaurant was opened in its vaults. It has proved quite popular.

The Silk-Cotton Tree

HERE is a photograph of one of the rare trees—the silk-cotton tree, snapped at the Bahama Islands. This tree gets its name from its thick, woody seed-capsules, which contain a fiber used for making floss and stuffing pillows. The checkerboard effect is produced by gum rubber applied as a preservative.

The silk-cotton tree is one of the forest's giants, attaining a height of over 130 feet and enormous girth.

Preparing for the Dry Season

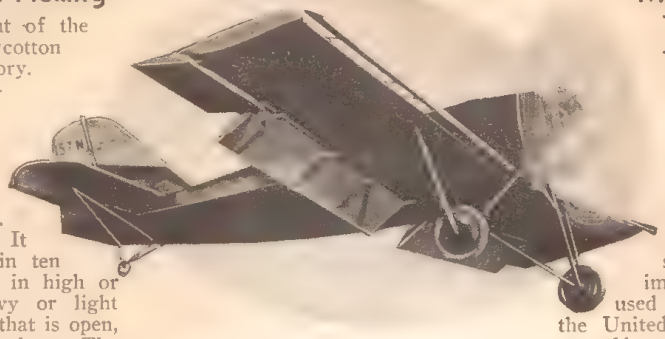
THESE African bushwomen are all prepared for the season of drought. They fill ostrich eggs with water, stuff the holes with tufts of grass and store the eggs until they are needed.

Have you any WOULD YOU BELIEVE IT photographs? We will pay five dollars for every photograph accepted and published on this page. Send them in to the Editor.

Mechanical Cotton Picking

THE long familiar sight of the Southern darkies picking cotton will soon pass into history. After twelve years of experimental work, a cotton picking machine has been passed by U. S. representatives of the Departments of Commerce and Agriculture, as ready for distribution. It will go over eight acres in ten hours, and operates easily in high or low ground, and on heavy or light cotton. It picks all cotton that is open, and in no way injures the plant. The machine, invented by Albert M. Hananer, was tested at the Delta Experimental Station, at Stoneville, Miss.

Wonder what Eli Whitney, who invented the revolutionary cotton gin in 1793, to separate the seeds from the cotton, would say to this?



The Doodlebug—Another Fool-Proof Plane?

EVERY once in a while an inventor brings forth what he is convinced is a fool-proof, safety plane . . . one that will not stall in the air, tail spin, side-slip, nose-dive, pitch-pole or capsize while being landed. The latest claimant for the title of designer of a safety plane has been startling flyers at the Washington Airport recently with his "Doodlebug." Here we see it floating to a landing. Note the appendages to the wings. By means of its wing slots and flaps, this low wing monoplane is said to be able to make miraculous take-offs and landings in a very small area. The plane was designed for last year's $100,000 Guggenheim safety plane competition, won by the Curtiss *"Tanager."* Due to a mishap, at the last minute, the "Doodlebug" could not compete.

Music to Order

IN our *Spotlight of Science* last month we showed Monsieur Martenot with the Martenot that he used in France. Should you not recall it, this instrument has the ability to mimic almost any known instrument of an orchestra, from the violin to the organ. Our photograph shows the inventor with the improved instrument he has used in making a concert tour of the United States. In appearance it resembles a spinet. It produces sounds through vacuum tube oscillations transmitted through a diffuser to a device that resembles a loud speaker. Some music critics have prophesied that it will be the basis for the musical instruments of the future.

Breaking the World's Largest Liner Record

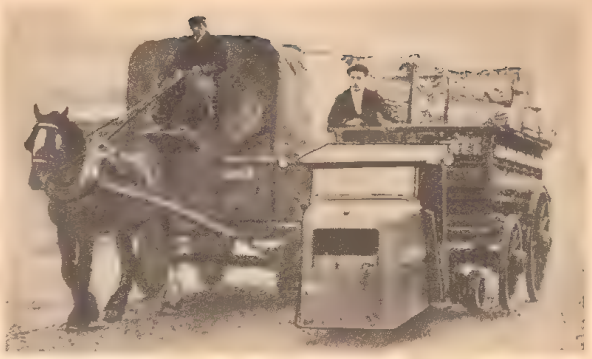
WITHIN the next two years, the latest Queen of the Seas will be launched. The Cunard Company, Liverpool, has engaged the John Brown Co., Ltd., of Clydebank, Scotland, to construct a mammoth liner, to be larger than the *Leviathan*, (which holds the world's record at the present time for being the largest steamship in the world). Work has been begun already; laying the keel is well under way. The new boat is expected to cost between $22,500,000.00 and $25,000,000.00. Its cubic capacity will be 7,300,000 feet, and its length 1,018 feet. It will weigh approximately 73,000 tons; the *Leviathan* weighs 59,957 tons. It will have nine decks above the water line and be equipped with a stream-lined, bulbous-prowed hull to gain speed. The launching will take place within two years.

A scale view of the Cunard liner now under construction.

Does This Spell Dobbin's Doom?

DOBBIN, the old faithful, who has clung so desperately to his place among commercial means of transportation, seems to be downed at last. Soon we may have no more horse-drawn vehicles in our streets. In their stead, we may have mechanical horses, such as the one pictured beside the animate animal. Both are leaving a London railroad station with carloads of merchandise.

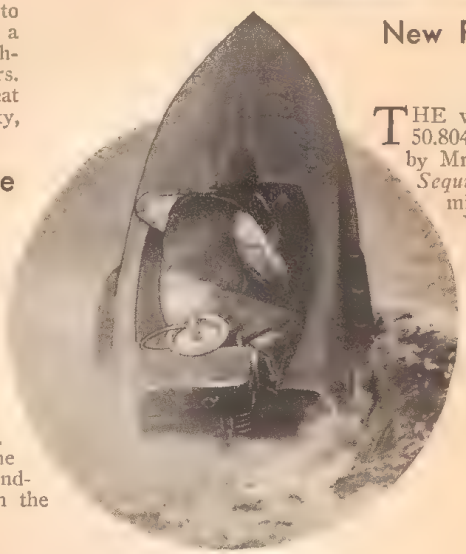
In January, 1931, the mechanical horse made its debut in London. It closely resembles in appearance the station trucks employed by railroads to transfer baggage. The vehicle made a hit in London, where business thoroughfares are already dotted with these cars. As is readily apparent, they are a great improvement over horses, for safety, speed and general efficiency.



The mechanical horse, as this new truck has been called, is expected to displace horse-driven vehicles in the London streets. It is somewhat similar to the baggage trucks utilized in our railroad stations.

An Hour's Extra Sunshine

PEOPLE living at the top floors of our modern skyscraper buildings get about an hour's more sunshine a day than those inhabiting the lower floors. This is because, as the sun sets, the shadow of the earth climbs up a structure at the rate of a foot in about two-and-one-half seconds. For a tall building, there might be half an hour's extra sunshine at sunset; similarly, half an hour's extra sunshine in the morning, for it would take a corresponding time for the sun to climb down the building.—*S. Leonard Bastin.*



New Record Set for Outboard Motor Boats

THE world's outboard motor boat record of 50.804 miles per hour was broken recently by Mr. Harrison in his tiny craft, the *Non Sequitur*, pictured here. He achieved 52.09 miles per hour, at Cowes, the Isle of Wight, thereby capturing the only sea or air record which Britain did not hold. His craft has one of the largest outboard engines ever built for a boat. Only five square feet of the craft are in the water, at top speed. The attempt was witnessed by an official of the Marine Motoring Association.

Making a Complete Record of Subway Noises

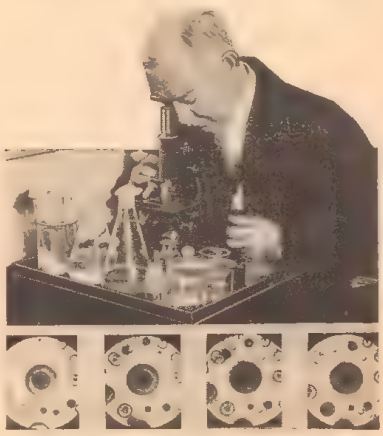
THE chief source of noise in the New York subways is the acceleration of motors, according to the first tests made by acoustic engineers of the Electrical Research Laboratory for the Interborough Rapid Transit Company of New York City. For a ninety-day period, these engineers will conduct tests in subway and elevated trains, of both inside and outside noises. Their findings will be utilized for the future reduction and elimination of all subway noises. They plan to use devices to abate noises, and sound-deadening materials in constructing cars.

One of the first cars tested was a twenty-five year old one. It will serve as a basis for comparison with new cars, to be accorded trials shortly. In the photograph, we see the experts installing the sound recording apparatus. In addition to a sensitive noise meter, there is a filter to determine the audible range of certain sounds, and to segregate sounds; a condenser microphone for inside recording, and another microphone to pick up outside noises.

It was discovered that usually more noise entered the train through the inside microphone than through the outside one (which had been installed in a partly opened window), and that the rattle in the structure of the old car created considerable disturbance.

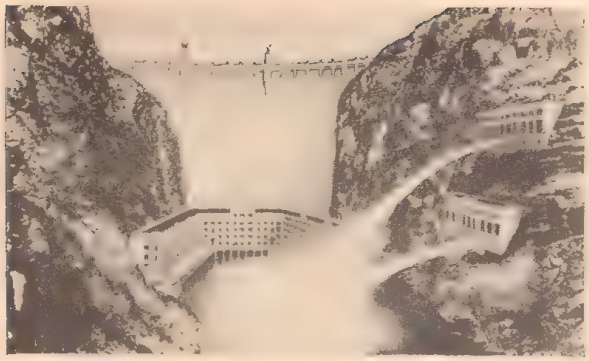
Engineers adjusting the apparatus with which they expect to measure and classify all subway noises. Their findings will be utilized to eliminate such disturbances. Sound-deadening materials for subway cars, motors, tracks and tunnels, and the padding of steel rails are being considered.

Artificial Creation of Life



AUTO-SYNTHETIC cells—or life-like cells, have been created by Dr. George W. Crile, of the Cleveland Clinic, in his search to discover the cause of cancer. In the photograph, Professor C. E. McClung, of the University of Pennsylvania, is viewing these tiny marvels through a microscope. Directly below are micro-photographs of some synthetic cells.

The research work of Dr. Eliot R. Clark, of the University of Pennsylvania, who recently perfected a method of microscopically studying the growth of living tissues in warm-blooded animals, and of abnormal cellular reactions, is also expected to prove of great value to the medical world in vanquishing that dread disease, cancer. This method, it is expected, will ultimately be employed with human tissue.



The Hoover Dam, when completed in four years, will be the highest dam in the world, 587 feet above the present water level . . . The Colorado River is to be diverted through four tunnels hewed out of the mountainside to permit of the construction.

Hoover Dam to Be Highest Attempted

HOW the Hoover Dam will look when completed, according to the plans of the engineers and architects, can be seen from this sketch. It is to be the greatest engineering project Uncle Sam has attempted since the Panama Canal was started. Before starting the construction, it will be necessary to temporarily divert the Colorado River through four tunnels driven through the mountainside. The dam is planned to be twice the height of the highest dam extant in the world today. It will be 730 feet high, higher even than the Washington Monument and rise about 587 feet above the present water level.

Government officials have scheduled actual construction to begin on April 15th. When the dam is completed, in about four years, it will be utilized for supplying power, drinking water, irrigation and serve as a flood control.

The dam was first called the Boulder Dam, because of its location at Boulder, Colorado. It has been renamed in President Hoover's honor.

This Golf Putter Holds Score Card

Scoring on the putter head.

A GOLF putter which has a recess in the back of its head to hold a score card has just been invented by C. A. Barden, who is shown scoring on one of the clubs. The score card is shaped to fit the putter head. The printed card is slid beneath suitable guides in the specially prepared putter.

No More Stops for Gas

LAST month one of the patents described in *Among the Inventors*, was a plane-refueling system. The

landscape was to be dotted with emergency refueling stations, each to include a tower, storage tank, pump, and hose. From the needy plane a grappling iron would be lowered to make contact with the hose. The upper portion of the refueling tower would be rotated to keep pace with the airplane, circling above. The plane's tanks could be filled within very few minutes. Perhaps. . . .

At the All-American Air Meet in Miami, another stunt was tried out. E. F. Leeks piloted a midget plane. When it needed gas, the refueling line was thrown out and successful contact was made with an equally tiny automobile at the Municipal Airport. A good deal of jockeying for position took place between the car and the plane, it must be admitted, in order to make the contact. Still, "stopping for gas" may be removed eventually from the vernacular of both aviation and motordom.

How Much Copper Has Milk?

AN improved method for determining the amount of copper in milk and other dairy products has been brought forth by H. T. Gebhardt and H. H. Sommer, of the Department of Dairy Husbandry of the University of Wisconsin.

Such a test is important because minute quantities of copper, though beneficial in some diseases, are harmful if present in dairy products from which foodstuffs are manufactured. The new test is a modification of one based on the green color reaction of copper with potassium thiocyanate and pyridine.

"In the past, copper has been considered toxic or undesirable in foods," the report of Messrs. Gebhardt and Sommer reads, "but today it is generally known that copper is an essential constituent of most plant and animal materials, and that it plays an important role in life processes. This has been definitely shown by the recent work on the function of minute amounts of copper in the cure of nutritional anemia.

"However, in the manufacture of many foodstuffs, it is still desirable to keep the copper content at a minimum for technical, if not legal, reasons. This is essentially true in the case of dairy products.

"The new method was evolved in connection with experimental work to determine the solubility of copper in milk. The method is also applicable to the detection of copper in other foodstuffs and biological materials."

Moon Varies Speed of Clocks

THE most accurate clocks in the world, the three Shortt clocks, were checked against a vibrating quartz crystal in the Bell Telephone laboratories. A striking fact noted was that the pendulums of the clocks are pulled first one way, and then the other, by the moon. When the moon is rising in the east, its gravitational pull moves the pendulum toward it; when it sets in the west, the action is reversed. In twelve hours, a clock loses or gains about fifteen hundred-thousandths of a second.

Gone, But Not Forgotten

BACK in the 1900's one bought an automobile and hoped the engine and other necessary parts were where they should be. The cry of derision, "Git a Hoss," followed the pioneer automotive exponent through the streets. Imagine what a novelty a car was in the late nineteenth century. We take pleasure in introducing "Violet," a steam-driven, oil-burning car, the first ever built in America. It has been preserved at Luna Park in Los Angeles, since its first appearance in 1892.

Lately Ralph de Palma drove it in the park at eight miles an hour!

Floating Gambling Palace Anchored Off the Florida Coast

THE laws of the United States may not be rigorous enough for Mr. Average Citizen who is afraid of the hold-up man, the second-story man, and the "con" man; and he may object vigorously to laxity in their enforcement. But the owners of the palatial gambling casino anchored beyond the three-mile limit considered our laws a trifle too severe . . . and that, most likely, explains why the *S. S. Monte Carlo* is a floating gambling palace. Fast speed boats, capable of carrying seventy passengers, make it easily accessible from most of the cities on the west coast of Florida.

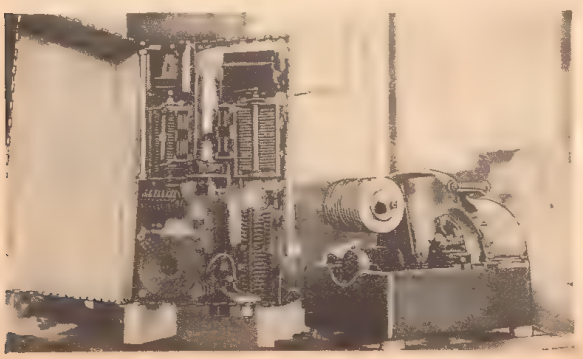
At least, since its opening on New Year's day, wealthy sportsmen have found it quite simple to get to the roulette wheels and faro games, baccarat, stud poker, and other forms of entertainment in which it is quite easy to lose your money. The gambling palace, said to be the most thoroughly equipped vessel of its kind in the world, is anchored three miles off shore from St. John's Pass, St. Petersburg. Chance games of all kinds are permitted on the vessel.

The S.S. Monte Carlo said to be the most elaborately equipped gambling house in the world; note the passenger entrance through the side of the liner, where the speed boats tie up. Below, an interior view of the floating gambling palace.

Radio Curtails Lifeboat's Perils

SOS—SOS—SOS—The call comes from a tiny lifeboat, bobbing up and down on a storm tossed sea, with a dozen people huddled together, wondering how long it will be before their boat will capsize . . . 100 miles away a vessel turns from its course and unerringly steams to the small boat. Another ship, perhaps sailing in another direction, picks up the call, gets the bearing from its radio compass, and steams to the rescue. . . .

This bit of sea drama may soon become an actuality, if the invention of Ralph Heintz, San Francisco radio engineer, is put into general use on lifeboats. A radio installation is carried by each lifeboat for sending out calls for help. The generator is motivated by a miniature gas engine, weighing only 36 pounds. A gasoline tank holds a supply for over 300 hours running. Already the officials of the Dollar Liners have announced that the lifeboats of all their new $8,000,000 turbo-electric liners, such as the "President Hoover," which was recently launched, will be equipped with this apparatus.



The gasoline driven generator and all of the wireless installation to be placed in all lifeboats of the new $8,000,000 turbo-electric Dollar liners. The compact equipment weighs but thirty-six pounds, and is capable of continuously transmitting a distress signal for 300 hours.

Whistles from the Earth

REMARKABLE whistling tones, of unknown origin but apparently coming from the earth itself, have been heard by German observers during the World War, when attempts were being made to detect enemy telephone conversations by picking up stray earth currents circulating in the ground.

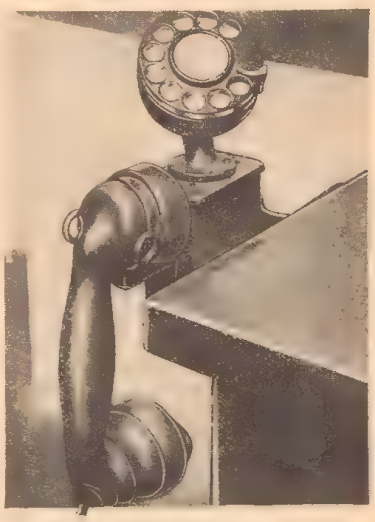
The tones were described as beginning with the highest audible pitch, passing down the entire scale, and becoming inaudible with the lowest notes. The sound, as nearly as can be expressed in words, was "peou." The sound lasted one second, and at times, especially during warm days in May and June, was repeated so often that listening-in became impossible.

An explanation has been suggested by Dr. Barkhausen, noted German physicist, who says that perhaps their origin is in lightning flashes. Radio waves are reflected from what seems to be a stratum in the upper atmosphere, about sixty to eighty miles high, known as the "Heaviside" layer. Dr. Barkhausen shows mathematically that a wave generated by a lightning flash may be reflected back and forth at a changing angle, so that a sound is produced which decreases rapidly in pitch.—*Sterling Gleason.*

Thirsty Plants Store Water for 15 Years

"A TREE cactus may hold many hundreds of gallons of surplus water," says Dr. Daniel T. MacDougal, Director of the Desert Laboratory at Tucson, Arizona. "Many plants in that region (the arid stretches of Arizona and Sonora) have now a water supply laid in which would keep them alive until 1933 or 1934. An acre of cabbage will use 2,000,000 quarts of water in a season, and 200 beech trees on an acre require nearly double that amount. One of these trees loses about eighty quarts of water as vapor daily from its leaves." He also pointed out that some vines store enough desert water in an expanded base to serve as a fifteen-year reserve for sustaining life.

New Type Desk Dial Telephone



A NEW desk telephone has been devised to accommodate those of us who find it necessary to utilize every square inch of desk space. It is attached to the side of the desk, as can be seen, and is placed within easy reach of the occupant, as he sits in his chair. The dial faces the user, is well within arm's reach, and is clearly discernible. A particularly good feature of the new instrument is that it eliminates annoying and untidy phone wires on top of the desk.—*Leo F. Wood.*

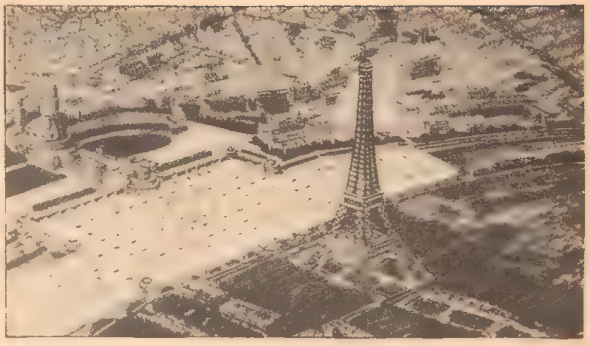
The Clock of a Thousand Miracles

A WHOLE day's entertainment is provided in watching this "clock of a thousand miracles," which required twelve years for Franz Tesar of Vienna to complete. One gets slightly dizzy just listing the services which it will perform. It is the only one of its kind on the earth, and seems to register everything which can be registered.

In the center is an ordinary clock. To the right are dials which show the month of the year, and the star supposed to rule that month. On the top to the right is a painting, which changes

automatically each week, and indicates the phase of the moon. At the same level to the left is a colored painting to portray the position of the sun; it shifts its position gradually, as does the sun in the sky. In the morning, the sun rises on one side of the painting; at night it sets on the other side. On the right side, at the base, are two figures which move every fifteen minutes.

Underneath the sun painting is apparatus to automatically indicate all the days of the week. On the side walls of the clock, smaller clocks show the exact time in London, Moscow, Prague, and Astrachen. All the apparatus works automatically. To cap the climax, songs are constantly being played, night and day, while the figures on the bottom move in rhythm. It takes a quarter of an hour to complete a song.



The Paris of the future, as depicted by Romain Delahalle. The big platform extending over the Seine River, connecting the Eiffel Tower and the Trocadero Palace, is to be a landing field for planes.

Gold Rush in Cuba

THE ice-bound fields of Elk Lake, Ontario, are still receiving hordes of adventurers, eager to dig for gold.... And down in sunny Cuba, at the southeastern end, they are getting a taste of the same mad rush. Cuba's sons are rigging themselves in tropical linen and forgetting their traditional languor to betake themselves to the mountains of the Oriente Province, where gold is reported to have been found. A queer mixture of ox-carts, automobiles, and an occasional plane can be seen dotting the mountainside. The fur-lined caps, mackinaws, heavy boots, storm shoes, and fleece-lined gloves the gold seekers are wearing in Canada, are out of the picture here.

One of the first to stake out a claim was Wolsey H. Field, an American citizen, and a nephew of Cyrus W. Field, who laid the first cable across the Atlantic. He is working on a huge plot which he has named Purisima. It is rumored that he has already left for the United States with one plane load of the precious ore.

The Paris of the Future—A City of the Air

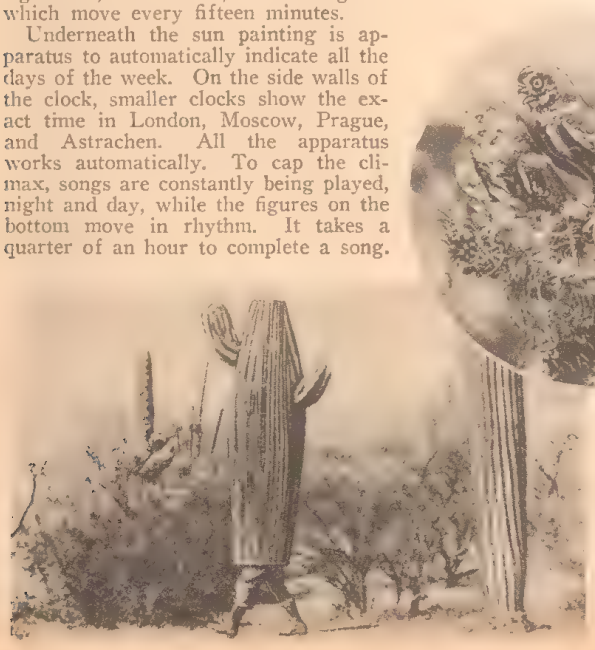
THIS is a prophetic sketch of what Paris will look like several years hence . . . visualized through the eyes of the famous French painter and architect, Romain Delahalle. According to Monsieur Delahalle, an immense platform will be built over the Seine River between the Eiffel Tower and the Trocadero Palace. It will serve as a landing field for airplanes, which, of course, will be the accepted means of communication and transportation at that time. The Palace of Trocadero is to be eventually converted into the official headquarters of the Airport Administration. And why not transform the Eiffel Tower into a mooring mast for giant airships? That's one idea the clever artist overlooked. It would be the only high tower in the center of a great city used in this fashion, except for our Empire State building in New York City.

If Paris is remodeled this way it could be called the City of the Air.

A Cactus Plant Takes a Stroll Through the Desert

LOOK a little closer, folks, and you'll see that this cactus plant is not a plant. It is just a blind rigged up to represent a giant cactus. Underneath its cover, as you can see from the protruding feet, a man was concealed from the searching eye of the desert animals. It was his business to take a photographic record of their movements, as they went about their daily routine. Since many of the animals photographed were quite shy, this was the way that the members of the Finley-Pack Expedition of the American Nature Association and Nature Magazine achieved their aim. This year the members were to learn all they could of the animal inhabitants of the Mexican border, and the wild folk of the Saukaura Forest of Arizona.

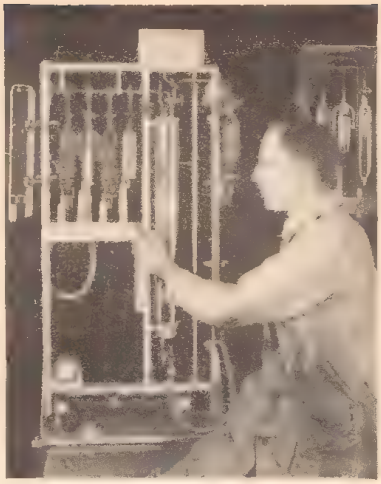
They returned with a wealth of interesting material, among it being several photographs of animals taking care of their young. This was the first time that the home life of some of these shy creatures has been recorded. So effective was the cactus disguise which the official cameraman, W. A. Van Scoy usually wore, that many of the desert animals, completely taken in, walked right up to it without knowing that they were being "shot" from the inside.



Elf owls on a chollar cactus, one of the most pricky plants of the desert. These birds feed on crickets and grasshoppers. Left—The photographer with his disguise.

New Device Developed to Analyze Gas Mixtures

ORSAT is the name which has been given to the analytical apparatus perfected by scientists of the Bureau of Standards at Washington, to enable them to analyze gas mixtures accurately. While it is, of course, not the first gas analyzer to be put on the market for commercial use, it is said to embody many improvements and eliminate some of the faults of the others. It is expected to work a great economy in several fields. It can readily be used for testing the constituents of natural gas in wells; for testing gases which escape from furnaces to see if the combustion is perfect; and to test gases liberated in mines; as well as for preparing poisonous gases for warfare use. This is but one of the many devices perfected by the Bureau to complete its tests.



J. D. White, of the Bureau of Standards, with the Orsat.

Air Transport Acts as Moving Van

AIRPLANES have served many purposes . . . here's a new use for one. Though we'll admit it might prove a trifle too expensive for your family and mine, and perhaps quite difficult of accomplishment. When the National Air Transportation Company decided to move its offices and shop equipment from Hadley Field to its newly completed offices and hangars at the Newark Metropolitan Airport, eleven planes, comprising its eastern fleet, were pressed into service as moving vans.

One of the planes being loaded preparatory to the journey to its new home.

This Shoe Defies a Battering Ram!

"OUCH, my toe!" is a forgotten phrase for thousands of industrial workers, because of a new type of shoe specially designed for their safety. In style, weight, and appearance, it resembles ordinary foot gear. But underneath its polished toe is a bridge of material strong enough to withstand the heaviest of blows and sharpest of edges.

Wearers of the shoes have been known to drop packing cases, pieces of machinery, even sheets of glass as big as the one pictured, right on their feet, without sustaining any ill effects.

Special attention is being accorded foot protection by the Western Electric Company, and that's how the shoe came into being. Shoes were specially designed and tested—everything from kicking them around as footballs to bathing them in artificial perspiration was tried. They were even pounded by the ram of a tension testing machine; the toe box was constructed of an impregnated non-inflammable fibre.

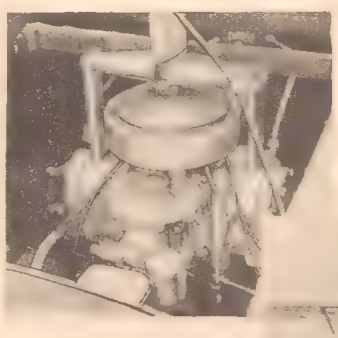
Revolving Telescope Platform

FROM the River Works of the General Electric Company at West Lynn there was shipped a piece of astronomical equipment which is the first of its kind in the world. It is an observer's platform that revolves in any desired direction, enabling a person making observations with an astronomical telescope to follow the telescope in its rotation. Electric motors, placed within easy reach of the observer, motivate the platform. Its destination is the Harvard Observatory at Bloemfontein, South Africa.

Two-Seater Baby Flying Boat

IN lieu of a new roadster, you can buy a two-seater baby flying boat in which to take out your best girl. The cost of the plane will bear comparison with that of a good car. Henry Booth has designed a new plane to retail for about $1,500.00. It is powered with a four cylinder, 32-horse-power Johnson Outboard Engine, and has a wing spread of 28 feet. It has already achieved an altitude of 8,000 feet and only consumed three gallons of gas an hour while doing this. The craft has a landing speed of 36 miles per hour, and will put the automobile to shame for speed, with 75 miles an hour, safely. When fully loaded it weighs only 700 pounds. The lower photograph shows Paul Nace, pilot, in the tiny cockpit, and the designer, Harry Booth, at the side of the plane.

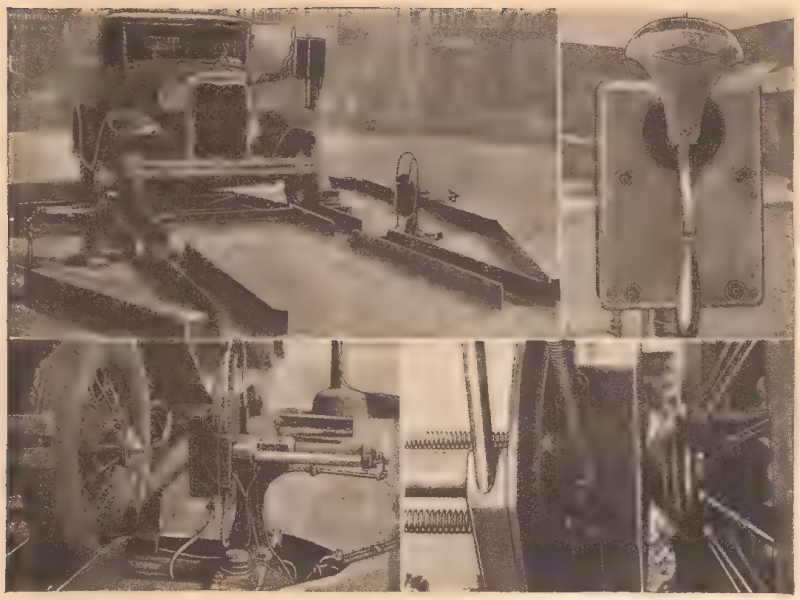
The development of flivver planes at low cost is bound to popularize flying.



A close-up of the motor of the baby plane, located in the hull of the boat. Below, Henry Booth standing alongside his plane at Amityville, Long Island.

The Smallest Screw

THE smallest screw machine product known to be made is a screw used in a watch. When magnified forty times it looks like a ⅜ inch cap screw, an inch in length. It is actually thirty-four thousandths of an inch in length, and twelve thousandths of an inch in diameter at the head. It has 360 threads to the inch. It takes 482,000 of these screws to weigh a pound.—*W. J. Miskella.*



Automatic Tire Inflator for the Motorists

OVER $600,000,000 is wasted yearly by the motoring public, merely because the average motorist neglects to inflate the tires of his car to the correct pressure, or check them often enough to insure the maintenance of proper inflation.

Ellis E. White and Roy Rowland of Los Angeles, after two years' work, have devised a fully automatic, accurate, and speedy tire inflator which can be operated from the driver's seat.

Since the machine must function for all makes of American cars to be practicable, and serve as a complement to the compressors already installed in our service stations, the task was particularly difficult. A small steel ball-shaped air inlet is fastened to the car wheel as a permanent attachment, as can be seen from the lower left-hand photo. From it, a flexible tube is led to the valve stem, so that regardless of the position of the valve stem, the center of the hub remains a fixed point to which the machine can be fastened. The driver, by a swing of the control handle (upper left-hand figure) can set the device to yield the pressure required for his tires. The inflating heads connect with special couplings mounted in place of the hub caps on the wheels (the lower left hand picture); and while inflating the tire are in the position indicated by the last view. The upper right hand view shows the operating head and handle. On the head is located the indicator for the necessary tire pressure, and a scale graduated in pounds of pressure per square inch.

An Antitoxin for That Tired Feeling

ACCORDING to medicine, the reason we feel tired is that there accumulates in the muscles a poison or toxic produced by exertion or overwork. It has been identified by Dr. Weichardt, of Leipsic, as kenatoxin. By injecting a large quantity of it into the skin of animals, he observed that they tired as from over-exhaustion very soon after starting activity. And, strangely enough, when a very small quantity was injected, the animals showed a conspicuous increase in endurance . . . they could exert themselves twice as much as usual without undue exhaustion.

The doctor experimented with the serum, and perfected what he calls antikenatoxin. When injected into his own skin, and that of two of his colleagues who offered themselves as subjects, it gave them a surprising amount of endurance. When sprayed in a schoolroom without the children being aware of it, they showed an increase in energy. Perhaps it will some day be in general use.—*Dr. E. Podolsky.*

Adjustable Seat for Theatres

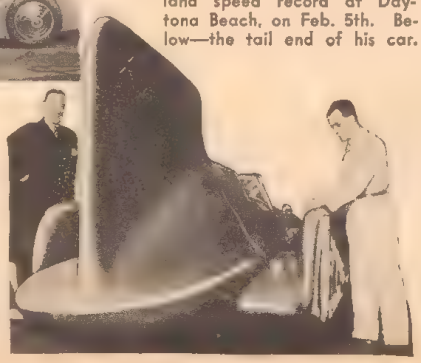
WE have all been annoyed in auditoriums, theatres, churches or halls when, just as the proceedings were becoming interesting, up popped the man or woman next to us. We had the choice of either standing up, to our own discomfiture, and that of those behind us, or being trod on. A special adjustable seat has been invented by Morris Hardman of Seattle, Washington, to do away with this inconvenience.

If you are seated and see someone wishes to pass through the aisles between rows of seats, you simply press your body againt the back of your seat, thus causing it to assume a vertical position, and simultaneously pulling the seat back sufficiently to allow a passer-by to walk without necessitating your standing up or being crowded. The new type seat does not take more space than the ordinary seat, as can be seen from the illustration.

He Set a New World's Record!

HERE we have Captain Malcolm Campbell in his new Napier-Campbell car, with which he attained a speed of 245.733 miles per hour at Daytona Beach, Florida, on February 5th, thereby establishing a new world's land speed record. He exceeded by 14.37 miles per hour the performance of the late Sir Henry Segrave, the previous record holder. A wet course, and a low, whitish mist made the feat particularly hard. In fact, the Captain almost missed the fairway because of the fog.

His car is equipped with an engine similar to that used in the seaplane which won the Schneider Trophy last year—a supercharged motor which is capable of developing 1450 horsepower.



Captain Malcolm Campbell in the cockpit of his new Napier-Campbell car, with which he raised the British land speed record at Daytona Beach, on Feb. 5th. Below—the tail end of his car.

Gathering Ore in the Famous Burning Mine

Steam escaping through fissures in the ground. Below—Ore-gathering trains 1500 feet below surface level.

FOR at least thirty-six years a large section of the United Verde Mine at Clarkdale, Arizona, has been called the "Burning Area." It extends from the surface of the earth to 700 feet below. In order to ensure safety for the miners, a wall has been built around it. The rest of the mine is considered fireproof. The upper photograph shows steam escaping through fissures in the ground at the mine. The lower one shows two ore-gathering trains at a junction 1500 feet below surface level. Sometimes the earth becomes so hot that miners stand on wooden boards; they find it necessary to encase their blasting powder in asbestos so as to prevent premature explosions.

Ore is loaded by steam shovels into trucks, from which it is dumped into a shaft leading to a railway 1000 feet below the surface of the land. It is carried through a tunnel for eleven miles before it reaches its destination, the smelter at Clarkdale.

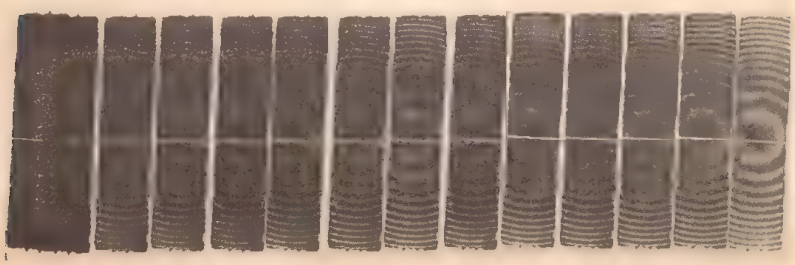
What Is Edible Gelatin?

HAVE you ever stopped to wonder just what gelatin is? And why the doctor recommends it for baby's food? Edible gelatin is a hard, tasteless, odorless substance which is almost white when dry, and transparent or translucent in solution. It is, of course, a protein food of high nutritive value, particularly in favor for desserts, ice cream, marshmallows and in preparing jellied meats. Gelatin is extracted by heat and water from the bones, white connective tissue, and skins of animals whose meat is used for food. Its chief distinguishing characteristic is its ability to form jelly, after being dissolved in hot water and allowed to stand. This is described by the colloquial verb "to jell."

Time Is Made Tangible

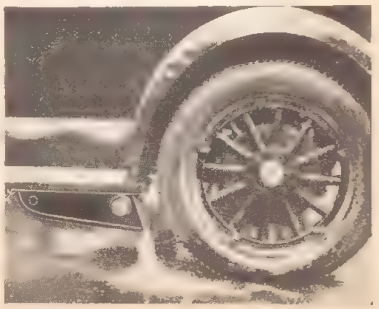
AT the California Institute of Technology, Pasadena, California, Dr. Roy James Kennedy and Dr. Leonard M. Thorndike are experimenting on time, just as if it were a tangible thing. They place it under a microscope, check its behavior under varying conditions, and photograph it. A mercury clock is utilized for measuring time.

When vaporized, the mercury atoms radiate a characteristic light, presumably in the form of waves, and the frequency of the waves, or the time interval between the wave-crests, serves as a pendulum to mark the flow of time. If in their experiments they find variations, they feel that they will know more than Einstein about the structure of his space-time universe. Below we have the photographic impressions with which they hope to prove or disprove Einstein's Space-Time theory.



Sanding Device to Prevent Skidding

THERE is very little danger in skidding if you attach one of these sanding devices to the wheel of your car. When it rains, when there is ice on the ground, and at all other times when your tire treads refuse to grip as they should, this attachment will come in handy. A lever at the driver's seat, opens the valve in the sand box and distributes a quantity upon the ground in front of the rear wheels, thereby preventing skidding. The system, a version of the sand box on steam engines and street cars, was developed by an Englishman, and demonstrated in England.



Locomotive Whistles—What They Mean

COMPARATIVELY few people in America understand the meaning of locomotive whistles. Some persons grow so accustomed to hearing them that although the sounds of the whistle are recorded by the ear, they are not noticed. This is a deplorable fact inas much as many locomotive blasts carry a vital message for public as well as for railroad men.

For example, as his train approaches a grade crossing the engineer *must* signal a warning consisting of two long blasts, a short blast and a long blast.

Another locomotive signal of prime importance to everybody consists of a succession of short blasts. (. . . . etc.) This is a warning to pedestrians and wandering live stock to get off the tracks. An engineer's salute consists of two short whistles (. .) meaning "Thank You" or "I Get You," etc. One long blast followed by three short ones (— . . .) signals the rear flagman to walk back along the track to protect the stalled train from any which may be following. Four or five blasts of *medium* duration (- - - -) recall the flagman.

One whistle of medium duration followed by two short blasts (— . .) calls attention to signals displayed for a following section. One short and one long blast (. -) has been recently adopted. It signals to trainmen that airbrakes are sticking. This signal until recently consisted of two short blasts given three times. (. . . .).—*Gilson Willets.* . . . .

$4,500,000 Metal-Clad Plane

WORK is under way to allot money to construct the proposed $4,500,000, metal-clad airship for the United States Navy. The new dirigible will be slightly larger than the Graf Zeppelin, and will have a higher speed. It will be designed to act as an air tender for a large fleet of planes, being equipped with devices which will allow planes to attach themselves to the ship while refueling and changing crews. By this method it will be possible for the great dirigible to convoy a fleet of bombing or observation planes thousands of miles without touching land. The plane will have eight motors of between 600 and 800 h. p. each and will be capable of flying 100 miles an hour.

Flying Taught by Mechanical Instructor

By John Henry Symington

Master the Principles of Piloting a Plane Without Leaving the Ground, and Enjoy Every Moment of the Process, in This Home-Constructed Trainer

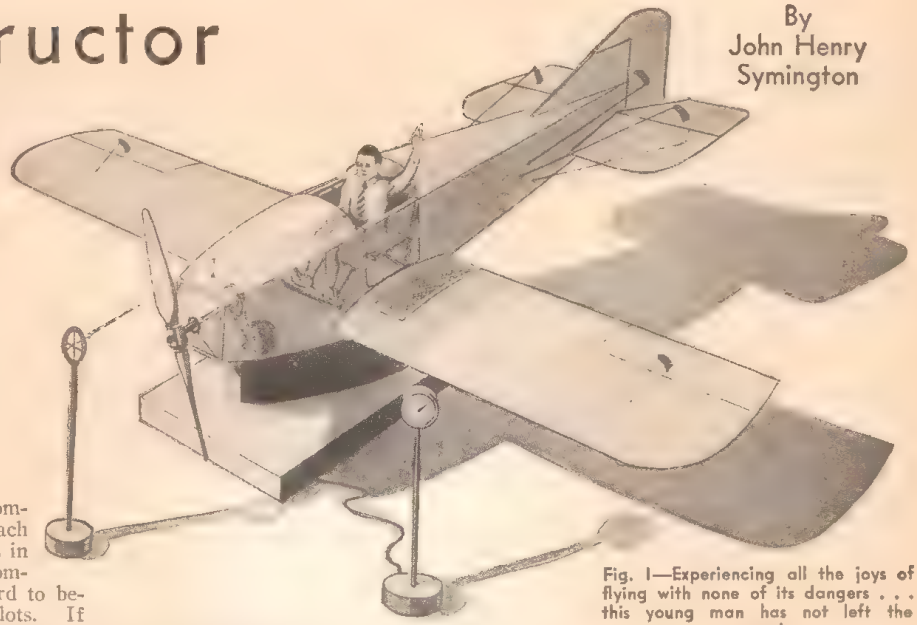


Fig. 1—Experiencing all the joys of flying with none of its dangers . . . this young man has not left the ground.

YOUNG America is becoming more air-minded each day. But because courses in flying are rather expensive, comparatively few of us can afford to become full-fledged aircraft pilots. If we could have our own pilot training machine upon which to practice flying operations, learning to fly would be made both easy and safe.

The accompanying drawings show you how to build your own pilot trainer, the mechanical teacher, which has been so highly recommended by many leading pilots. A world of fun is available with this trainer, for it allows you to go through all the paces of actually piloting a plane without leaving the ground!

The trainer is equipped with an adjustable error-integrating system, so that, as you become proficient in maintaining an even keel, you can make the allowable limits of variation in pitch from the level plane smaller; it will become more difficult to control the machine with a minimum of errors. And you needn't be ashamed of the number you run up at the beginning, either, for even the most experienced of pilots would find it hard to control the ship perfectly.

The miniature plane or pilot trainer can be caused to pitch around as well as rotate by any one of several means. One of the simplest is to use compressed air and a series of bellows as shown in the diagram, Fig. 8. Referring to Fig. 1 for the moment, it will be seen that a sight point or small ball is mounted on the nose of the trainer, and the student has to keep this point as near as possible in line with the target ring, which is supported on a portable floor standard. A "phoney" propeller is rotated at slow speed by a belt and electric motor; a fan motor serves the purpose admirably. The propeller, spinning slowly, gives the student a realistic effect of actual flight. Another method of causing the pivoted platform supporting the miniature plane to rise and fall involves the use of four airplane tires of the new spherical type; or one may make up four sections of inner tube as shown in Fig. 6. It is best to arrange these vulcanized or cemented sections of inner tube in wooden boxes with vertically sliding tops. As compressed air is passed into any one of these inner tubes inside the boxes with the movable tops, the top rises, and, by means of the link member, causes that side of the platform to rise.

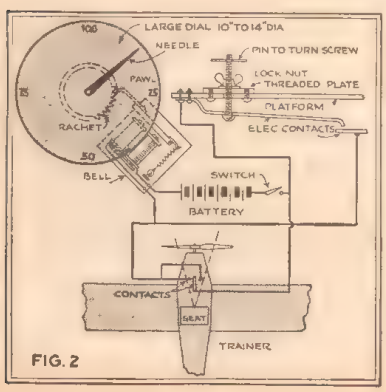


FIG. 2

Fig. 2—The way to put together the adjustable error-integrating system with which you get a register of your ability, and watch yourself improve.

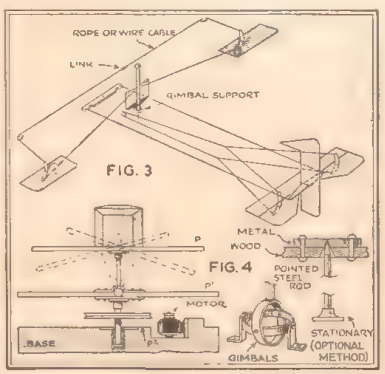


Fig. 3—By following this control-cable diagram you will get the ailerons, rudder, and elevators to function like those of the regular plane. Fig. 4—The platform upon which the trainer rests.

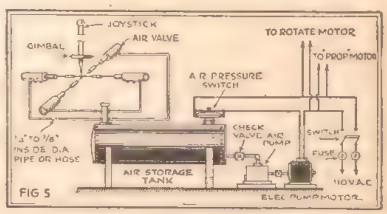


Fig. 5—The air tank and pump outfit, which comprise the compressed air plant. An old kitchen boiler may be utilized.

The diagram, Fig. 8, shows one design of compressed air control valve, four of which are needed. Right and left hand couplings or turnbuckles may be used to connect the bottom of the pivoted joystick to the various valve members, as shown in Fig. 8 and 8 A. This allows accurate adjustment of the valves and permits adjusting one of the valves so that it will always feed a little compressed air to one of the bellows (or other form of pneumatic elevating device used) so that the plane will be normally (*Continued on page* 1140)

The author at work.

Let an Indian Tepee Light Your Room

Novel Adaptations of Historic Objects Make Your Home More Interesting. A Model of a Blackfoot Tepee Makes an Admirable Lamp for the Boudoir or Living Room

By Charles Herbert Alder

TEPEES (or tipis) were originally buffalo hide, but the buffalo having been practically exterminated, they are now made of duck or cotton cloth.

This Indian tepee lamp is a small reproduction of an Indian tepee made about 1874 and used for more than a year by Heavy-runner, a noted Blackfoot Indian. Tepees have never been covered with silk or taffeta, but as this particular tepee is going to be used as a lamp and for decorative purposes, cover it with any material that you choose and call it "artistic license" (silk, taffeta, parchment or even painted linen).

The base is made of 3-ply veneer, ¼" thick by 12" in dia. The tepee poles are 13" long by 3/16" in dia. The two long poles that support the wing flaps are 15" long by 3/16" dia. spaced approximately 3⅛" apart. There are 11 tepee poles and two poles that support the wing flaps. The holes for the two long poles are made directly in between the second and third tepee poles counting both ways from the center pole in the back of the tepee. The holes for the poles are 3/16" diameter and form a circle 11" diameter. Drill the holes all the way through the base. Sandpaper the base and then give it a coat or two of black lacquer.

The tepee poles are 13" long by 3/16" dia. Make 11 of them; sandpaper and lacquer red. The poles for the wing flaps are 2" longer, or 15" long by 3/16" dia. Make two, sandpaper and lacquer red.

Courtesy Norman Furniture Co., Inc.

This young lady finds that a tent lamp is just the thing for her boudoir.

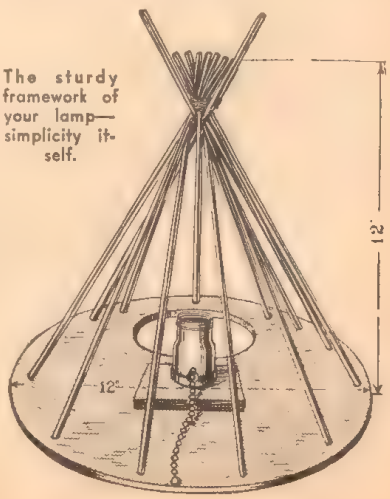
To assemble the parts, secure the lamp socket to the base. Dip the ends of the tepee poles in glue and put them in the holes in the base. Then bend them toward the center, one after another and secure them with a short length of string about 2½" from the ends of the poles; lacquer the string red. Next, put the two long poles in their holes and wrap a short piece of string around them on the outside of the tepee. The string must also be covered with red lacquer.

The last job is the cover for our tepee lamp. I used a combination gold and green taffeta that blends splendidly with nearly any color or combination of colors. Make a paper pattern, cut the cover to shape, roll the edges and sew neatly. Make a paper pattern for the wings, cut two wings and be sure not to make them both for one side. Sew the wings to the tepee cover and then put the cover on the tepee.

The points of the wing flaps are turned back over the wing flap and poles and sewed. Fold the tepee flap covers one over the other and sew neatly. To draw the edges of the tepee cover toward the base, between every two tepee poles drill two small holes 1/16" in diameter. I did this job last so that the holes would not be stopped up with lacquer. After the holes are drilled weave a piece of red silk cord in and out the holes and through the bottom edge of the tepee cover. When the ends meet, tie them. Put four small rubber feet on the bottom of the base and hammer a staple over the chain-pull so that it will not get out of reach.

To obtain a still more faithful and realistic reproduction, draw the cloth down flush with the baseboard. Then drive small stakes in the base at an angle as though they were holding the tent cover down. You can also fasten small metal balls along the edges of the baseboard to imitate rocks.

The rocks can be imitated by hammered metal balls.



The sturdy framework of your lamp—simplicity itself.

Try These in Your Own Home Workshop

Adaptations of Your Present Equipment Will Enable You to Enlarge the Scope of Work Facilitating What May Have Been Difficult Jobs

By Raymond B. Wailes

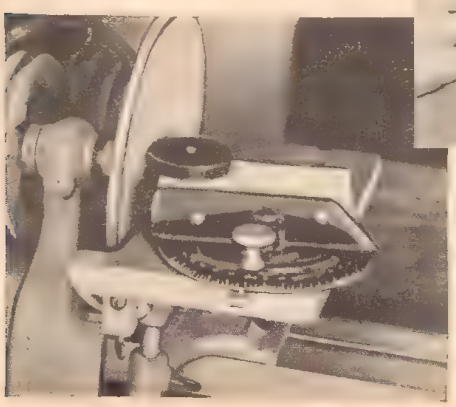
ONE will never have paint brushes whose bristles curl around like question marks if the brushes are supported while being cleaned of paint by means of a battery clip hanging over the side of the container. A wonderful cleaner or renovator for dried out paint brushes is made by dissolving one or two tablespoonfuls of trisodium phosphate in a pint of hot water, allowing the bristles to soak in this solution. The old paint is easily worked out. Wash in water after this treatment and dry. Several small brushes can be cleaned with a pint of this solution.

A very simple arbor or "steady rest" for turning long pieces of wood in the lathe is made by screwing a screw-eye into a round wooden dowel which is held upright by a tool support rest on the wood turning lathe.

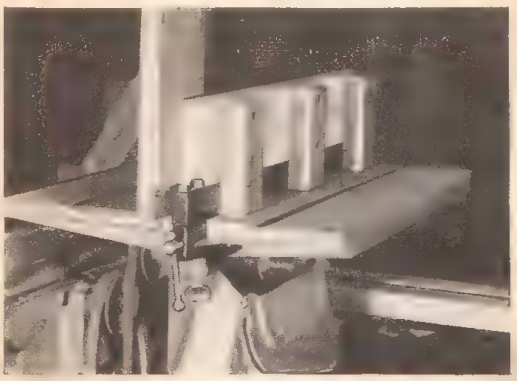
Chattering of set clamps on lathes, circular saws, jointers, and other motor shop equipment can be eliminated by slipping a very short length of rubber tubing over the loose handle. Keeping the rubber pressed tightly against the threaded body member will prevent the loose handle from shaking.

And who can't use a reamer? You can make one from a worn-out triangular file by grinding the sides down on the emery wheel and mounting one half of the file in a wooden handle. Don't burn the file and thus remove its temper when grinding, or it will be useless.

Make perfect wheels this way—The wheel blanks, being mounted on a wooden block base fitted to the protractor, can be moved against the sanding disc.



Your existing saw table fence can be made to give better service if it is equipped with a detachable apron-like side piece which increases the height of the fence and thus its working range. This addition can be very simply made and you will find it well worth your trouble.



Cutting cheeks on the ends of long material is performed very easily with such an additional height. The apron extension is slipped over the existing fence, and is held in position by two or three finger-like wooden strips.

Plucking that tiny screw out from all the other hundreds of screws in the shop junk box is accomplished with ease if one uses a pair of forceps. And the forceps will make a good prober for poking in the junk to locate that tiny screw.

An easily made addition to your saw table permits you to cut first-class cheeks on the ends of long stock. Below. Mount an old triangular file, with edges ground down, in a wooden handle, and you have an excellent reamer ready for work.

A simple arbor for steadying long pieces of work, made from a screw eye and a wooden dowel.

A pair of forceps are a great help when rummaging through your small parts box.

If you make wooden wheels for the toys made in your home workshop, they will never be lopsided if the following scheme is used. A sanding table is usually standard equipment on wood turning lathes. To the protractor is fitted a wooden block base in the same position as occupied by the work when using the protractor with the work in sawing with the circular saw. This wooden base carries the rough wooden wheel blank to be trued, or faced. By rotating the protractor on its swivel axle after unloosening the set screw, the wheel blank is brought up against the revolving sanding disc. The diameter of the wheels is kept the same by reading the graduations off on the scale. Of course, the wooden wheel blanks are rotated by hand on their own axles after being brought up against the sanding disc. In this way you can produce wheels or circular parts which will be absolutely true.

If you have any ideas for our workshop page, send them in to the Workshop Editor. We pay for them at our regular rates, if they are found available.

New Tools You Can Easily Make

Another One of the Monthly Series Which Describes the Construction of Entirely New Tools. You Can Make Most of These From Equipment You Already Possess

By Joseph Pignone

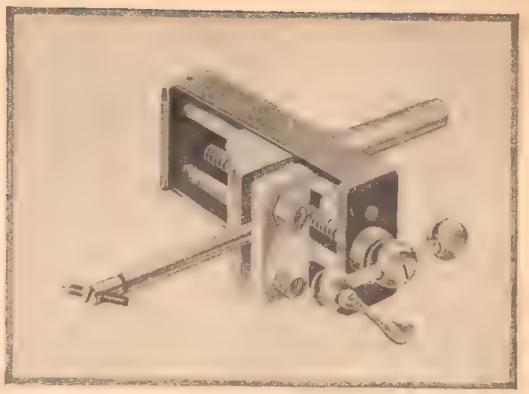
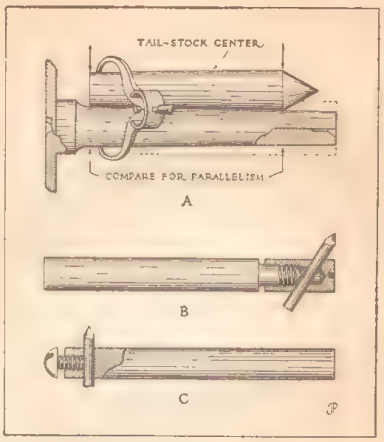


Fig. 1—The completed slide rest and boring attachment.

DUE to low power, high speeds and belt slippage generally associated with the smaller lathes, drilling a hole much over ⅜ of an inch in diameter in metal is quite impossible. Even then, the hole is almost never truly centered in circular work. By using this device as a boring attachment, however, it is only necessary to drill a hole sufficiently large to permit the entry of a boring bar with a short tool insert. Perfectly concentric and circular holes will result.

To use the tool as a slide rest, you need use some of the boring bars for outside turning as in C. of Fig. 2. while for facing, any conventional lathe turning bit will do. By clamping a point center in the tool holder, a third usage results—as a taper turning attachment; and again, by mounting a small vise in the holder, many small milling operations may be performed.



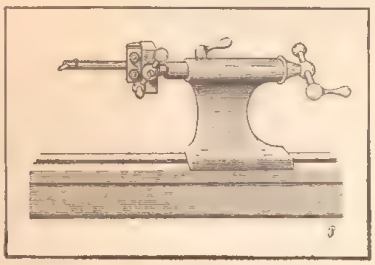


Fig. 2 — Detailing some of the adaptations of the tool.

Fig. 3—Assembled on the tail stock of your lathe—ready for work.

To construct the tool itself, there is comparatively little work involved. It is simply made from a drill press vise of the type illustrated in drawing, Figure 1. The vise consists of two jaws sliding along heavy rods mounted through a cast iron box frame. Cast integral with the frame and projecting from its bottom is a very heavy tange or rod.

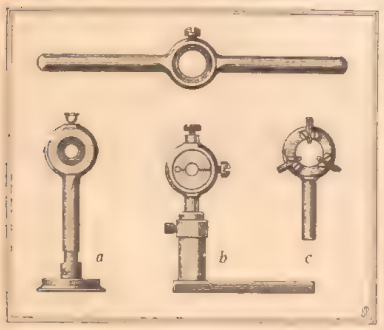


Fig. 4—A cheap die holder can be adapted to suit different purposes.

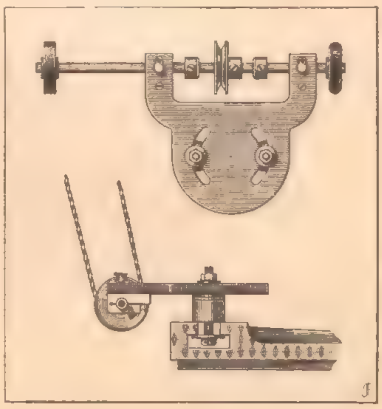


Fig. 5—The Slide Rest Grinding Unit.

First, remove the slide rods by drilling out retaining pins through the frame sides. Then remove the clamp screw by sawing the outside handle hub. A close inspection of the inside of the empty box frame will reveal a center hole. Clean this hole of enamel paint and mount the frame between centers in the lathe. Turn a taper on the tange to fit the tail stock spindle hole as shown in A of Fig. 2.

As the left and right handed vise screw is useless, make a new one left handed if the die is available. Next procure two set screw collars and tap their holes to fit the lead screw. One of the collars when set in place is used with a brass washer to bear against the inside of the frame, while the other collar is similarly mounted against the outside of the frame. By properly adjusting the collars and locking them, elimination of end play in the lead screw is assured. If no ball handle is available to mount against the outer collar, or if making one is not feasible, procure a 2½-inch iron pulley, turn off the V and force a rod into it near its circumference as a handle.

Finally, select the vise jaw which has the proper thread hole to fit the lead screw and will face the handle as in Fig. 1. Accurately file a V into the exact center of the face of this jaw. Make certain this V cut is of uniform depth and is square to the top edge of the jaw. Now drill and tap two rather large holes on each side of the V. A steel clamp bar is next cut and drilled, which, with suitable studs and nuts, forms an efficient tool holder against the former vise paw. Fig. 3. shows the tool mounted in the tail stock.

While the slide rods removed from the vise might be used again, an opportunity for greater accuracy and strength can not be overlooked. Procure, instead, drill rods of a diameter that will fit more closely into the jaw holes, and in turn, drill and tap their ends to receive small machine screws instead of the previous retaining pins holding the old rods in place. These small retaining screws through the frame casting permit of the (*Continued on page* 1143)

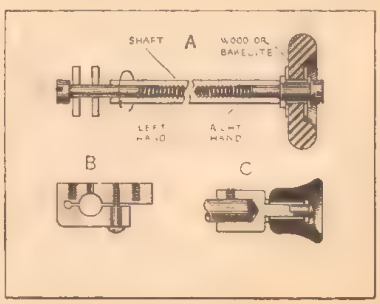
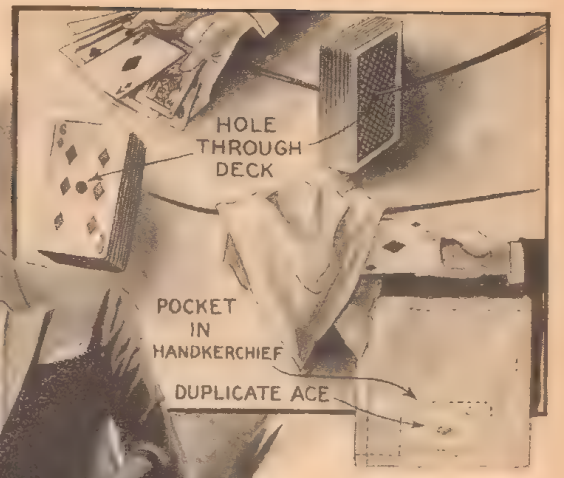


Fig. 6—Further details of the grinding device.

MAGIC

By Dunninger

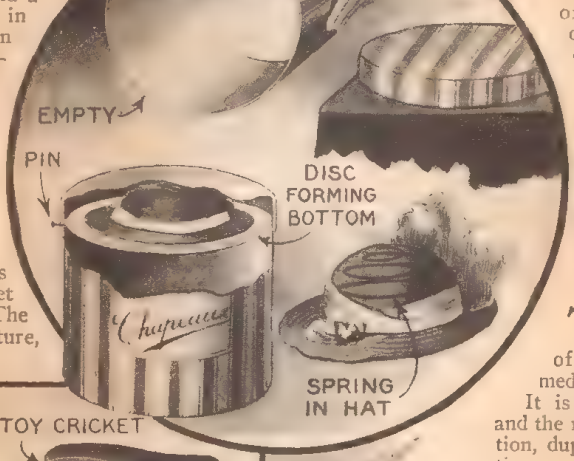
The master mind of modern mystery, who has mystified ex-Presidents Harding, Taft, Roosevelt, Coolidge, the Prince of Wales and other celebrities, presents another of his magic series.

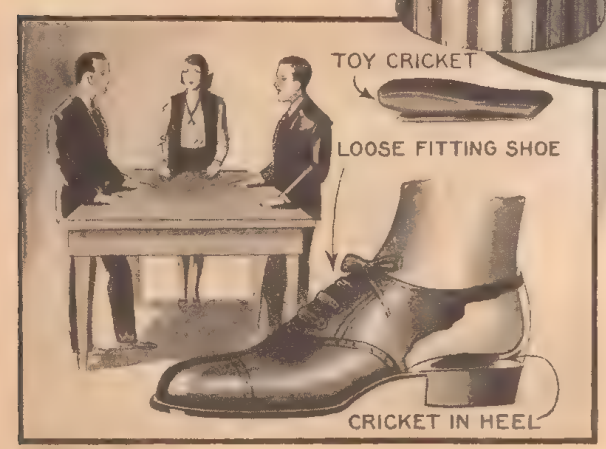


The Illusive Card

IN this very novel trick, a card is chosen from a pack; through the center of each card in the pack a hole has been punched. The selected card is shuffled back into the deck, and a ribbon passed through the hole in the pack. The ends of the ribbon are held by two facing spectators; the deck is covered with a large handkerchief. Reaching beneath the kerchief, the wizard draws forth a card, which proves to be the one originally chosen. It is passed for inspection, and found quite intact.

To present the effect, a card is forced. A duplicate in suit is concealed beforehand in a secret pocket in the handkerchief. The silk should be of heavy texture, rather large, and preferably marked with a dark, floral design so as to render its pocket quite invisible. Under cover of the silk, the wizard draws forth the playing card from the handkerchief pocket. The one originally selected remains in the deck, threaded on the ribbon. After the presentation, and while the card and ribbon are being examined, the wizard can easily locate and secretly palm the original card from the pack and dispose of it, before passing the balance of the deck for inspection.





Milady's Chapeau

HERE we have an excellent modernistic trick of the up-to-date variety, so much sought after by both amateur and professional. An assistant hands the wizard a lady's French hat box which he says contains a new hat. Upon undoing the ribbons, the magician is surprised to find that the box is empty.

As he is a conjurer, he attempts to remedy matters. He places the lid upon the box, and, after making a few mystic passes to emphasize his power, removes the lid. Reaching into the box he brings forth a charming plume-trimmed lady's hat, which he places upon the head of a smiling girl assistant.

The hat, although substantial in appearance, consists of nothing more than thin material built over a large, spiral spring. Thus the hat, when folded flat (in the manner of a gentleman's opera hat) requires very little space, and is easily concealed beneath a loose fitting disk, which forms a bottom to the hat box lid. This is held in place with a pin, which is drawn when the cover is placed upon the box. The rest is easy.

Language of the Spooks

THIS so-called spiritualistic effect is employed by some of the most prominent fraudulent mediums throughout the country. It is exceedingly simple to operate and the reader can, with a little preparation, duplicate it as a parlor demonstration.

A group of people are seated around a table, holding hands, as is customary in seances. Weird spirit knocks, apparently coming from different parts of the room, are distinctly heard. The phenomena take place either in a darkened room, or in brilliantly lighted one.

An inexpensive toy, known as cricket clicker, purchasable in the average toy shop for a few pennies, is the only essential (*Continued on page* 1144)

No. 91 of a series on magic appearing monthly.

Scientific Aids to Your Comfort

By Mary Jacobs

Just Press the Button!

WHEN you have a group over for an evening's entertainment, and you feel you'd like to have a game of cards—bridge, poker, pinochle, or rummy, just how long does it take you to assemble the necessary materials? Do you get the playing cards from one drawer of your table, the pencil from another, the poker chips from the cabinet? Not with this table. . . . Just press the button in the middle of its side, and up jumps part of the table top, revealing several good-sized compartments, specially fitted for your cards, pencils and score pads. It even has ash trays, so that you need not reach for the smoking stand, or push off your tray in moving your arm.

Portable Electric Sewing Machine

PICK it up by its handle, take off the walnut cover, and put in on your table. A sewing light behind the carriage of the machine insures proper illumination; a press of your foot on the foot-controlled rheostat starts the machine going. It has a positive thread take-up, an automatic tension release, an automatic bobbin winder that stops when the bobbin is full, a stitch regulator, and what is unique in any machine, a reversible feed. This feature is of great value in sewing the ends of hems where additional strength is required; it also eliminates the necessity of tying thread to prevent unraveling. Tested and approved in our laboratory.

Seat and Ladder

QUITE often, in the kitchen, you find it necessary to hang curtains or to reach into the top shelves of cabinets. And what a nuisance it is to get the ladder, or try to move the table within climbing distance! Why don't you get a combination kitchen stool and stepladder; one upon which you can sit comfortably while you wash dishes, iron clothes, or prepare foods? A back-flip of the top seat converts it into a firm ladder. The seat instantly locks in the upright position; the top rubber tread is specially shaped and has ample room for planting both feet firmly. The lowest rubber tread is quite satisfactory for resting feet while you work. The stool, when not in use, can be slipped away under the sink or table. It is sturdily constructed, finished with three coats of gloss enamel that permit frequent washing, and can be obtained in any color desired. Tested and approved in our laboratory.

Cut the Bread, Not Your Fingers

THOUGH slicing bread is such a common operation that each one of us has done it countless times, quite often we let the knife slip, and slice our fingers instead of the bread. And it is rare indeed when we cut more than one or two slices perfectly. But here, a downward movement of your hand on the knife is all that is required . . . result, a slice of bread or cake, neatly and evenly cut. Release the spring controlling the knife's movement down again; and you have another slice, uniform in thickness. This automatic bread cutter, which will prove equally convenient for slicing meats and vegetables, comes with a pretty tray for holding the food. It can be adjusted to cut foodstuffs into slices thick, medium, or as thin as you desire. Tested and approved in our laboratory.

Your Clothes Slide Into View

UNLESS you are one of the people fortunate enough to have a large, roomy closet, with a light inside, it is quite a task to get a dress or suit from it, particularly at night. To do away with this difficulty, a closet fixture, a rod similar to the ones used in showcases, has been put on the market. It operates on roller bearings in a metal sleeve; the nickeled rod from which your clothes hangers are suspended comes forward into the open room, at a slight touch of a lever, so that you can choose one garment from your whole wardrobe. It slides back just as easily. And a screw driver is all you need to fasten it to the underside of your top closet shelf, or across the closet. It will fit any type wardrobe, and can be obtained in sizes from 12 to 60 inches, in multiples of two inches. Tested and approved in our laboratory.

For Smoking and Drinking

TIRED of being scolded at home for smoking during a meal, and putting

(*Continued on page* 1152)

Names and addresses of manufacturers furnished upon request

Shelves for books and magazines, a desk compartment, two drawers for stationery, and a place for your pens and pencils are provided in this bookshelf-secretary combination.

Bookcases in the Modern Mode

The Old Style Heavy and Cumbersome Bookcase Has Been Displaced by Simple, Yet Roomy Bookshelf Combinations, Which Admirably Fit Limited Space, and which Can Be Made From Almost Any Wood Available

By H. L. Weatherby

Director of Manual Training, Montgomery County Schools, Montgomery, Alabama

This bookcase is easier to make than the other one, and is quite as attractive. In cutting the curves for the top of the sides and the back, it is a good idea to use a paper pattern.

A GREAT deal of our new modern furniture reflects the spirit of the age in which we live. Some of the furniture of bygone generations is much too cumbersome to find a place in our present small apartments. Particularly is this true of the old-time secretaries that reached well up toward the fourteen-foot ceilings of the homes of that day and time. The modern counterparts, although not as roomy, are quite as useful and decorative as the old ones were and fit into the modern scheme of building and decorating much better.

The combination bookshelf suggested herewith is not a secretary, but a modern substitute for one. It has a small desk compartment, two small drawers for stationery, a place for pens, pencils and ink, and shelves for books and magazines. It is truly a useful article of furniture for the study or living room and its construction is so simple that almost anyone can build it.

We would suggest getting out the two sides first. It is often hard to get twelve inch material. This being the case, a four inch board, about twenty-six inches long, can be glued along the edge and at the end of an eight inch piece sixty-four inches long. This will give exactly the shape desired for the sides and will prove to be a saving in material.

The sides and shelves may be made of ¾ inch material or from even thinner wood than this. The shelves should be made to follow the shaping of the sides, and may either be held by grooves or gains in the upright pieces or be fastened permanently in place with screws. For either method used, the greatest care must be taken to get all parts square and the shelves of equal length. In case screws are used they should be set well below the surface and the holes filled with wooden plugs or plastic wood.

The facing strips and moulding will add greatly to the appearance and are easily put into position. The moulding may be made by hand or can be purchased from the local mill. It is mitered, glued, and nailed in place. The facing strips are also glued and nailed into position.

Other trim is cut and placed, the drawer is made and fitted, the little door above the drawer is hinged, and the back is fastened into place. After a final sanding, filling of nail holes and general cleaning up, the bookshelf is ready for the finish.

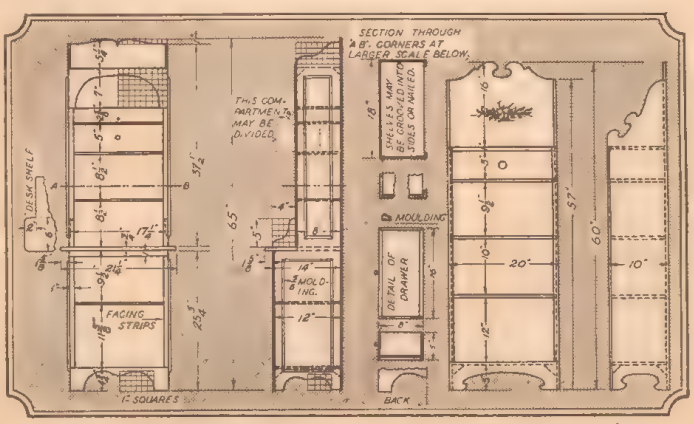
Where cheap wood is used we recommend paint, enamel or lacquer, since these will cover the surface so successfully, and nearly anyone can put them on with satisfactory results. Where a hardwood is used that is free of knots, we suggest that a stain be applied, followed by shellac and varnish.

With the other bookcase illustrated we have a piece of furniture that is simpler than the first one described. It has one drawer and several shelves for books. The back may or may not extend below the top shelf. The construction is similar to that of the one just described. The only difficulty that may be experienced in its construction may be in cutting the curves for the top of the sides and for the back. A carefully made paper pattern will simplify this, however, and with it pasted or tacked upon the pieces to be sawed, little trouble should be had in following this outline with a hand or power saw. A very careful filing or rasping and sanding will put the curves in first-class shape.

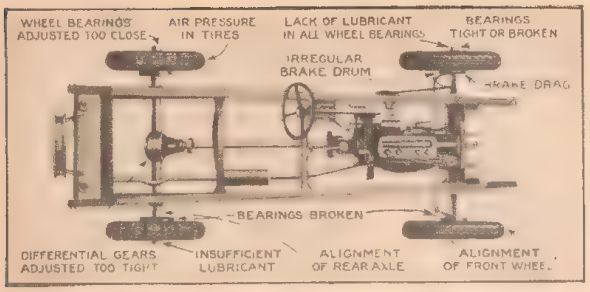
In case an enamel or lacquer finish is applied, a transfer design will look well on the back above the top shelf. One can be secured from paint stores, or from five-and-ten cent stores. Such a pattern adds a great deal to the appearance of furniture.

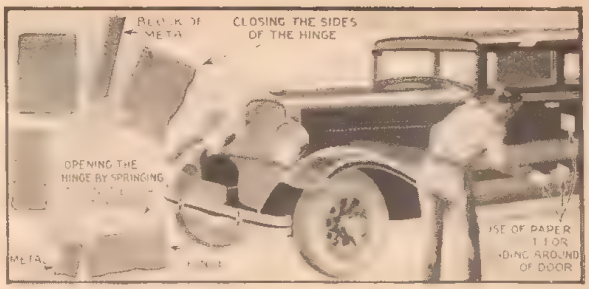
One other suggestion which applies to either of the book cases applies to material for the back. We would suggest the use of ply wood where this is available. It comes in the desired width and will not warp or split. It is strong and will serve well as a bracing agency, and it is already smoothed and ready to use.

It is best to purchase and assemble all the materials you will have to use for making either bookcase before you begin any of the actual (*Cont'd on page* 1142)



The construction diagram to the left covers the combination bookshelf and secretary; the one to the right, the bookcase pictured above, to the right.





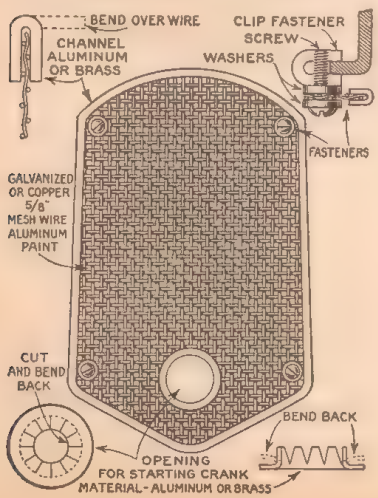
These illustrations indicate the sources of friction which may be responsible for unsatisfactory operation of your car, and low gasoline mileage. They are all easy to correct.

Taking Care of Your Car

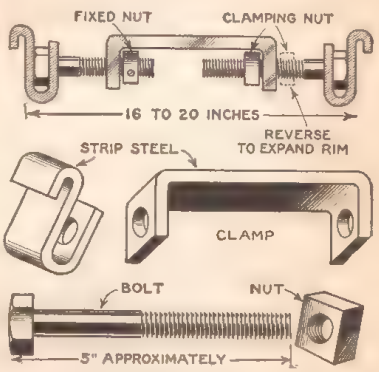
Does Your Car Roll Smoothly? Do Its Doors Sag? Would a Radiator Screen Improve Its Appearance? Can You Use a Good Split Rim Tool? Is the Windshield Always Clean? Read Arthur George's Suggestions

WITH all the talk and discussion as to the merits of free wheeling both here and abroad, the advantages of having the car roll ahead of the engine speed, with resulting economy in oil and gasoline consumption, are apparent. The car should coast without considerable restraining friction. If the engine is uncoupled, obviously the car is relieved of the restraint of a mass of mechanism which tends to slow it down. The engine, however, is only one of several sources of friction which when combined exercise an appreciable drag on your car's rolling smoothly.

The attached illustration indicates the sources of friction which should be inspected frequently. So many car owners are unaware that the cost of operating the car is dependent upon such conditions, and complain of the low gasoline mileage they obtain. The main detail in eliminating friction is to free the wheels, allowing them to revolve without binding because of faulty bearings, brake shoes, lack of lubricant and other causes. Among items to correct, adjust, repair or otherwise attend to are:



Strips of aluminum and galvanized iron meshed wire may be fashioned into a radiator screen of which you will be proud.



A home-made tool for handling split rims is both economical and efficient.

Brakes—Brakes dragging because of too close an adjustment.

Brake drums not true, and binding at some spots while the brake shoes are in released position.

Wheels—Front wheels out of line, causing a frictional drag on one front wheel.

Axles—Rear axle out of line, with resistance due to the wheels failing to track.

Tires—Air pressure too low, resulting in bending of tire sidewalls and resistance to rolling.

Bearings and Gears—Wheel bearings too tight and insufficient lubrication. Differential gears adjusted too closely and a lack of the proper grade of lubricant.

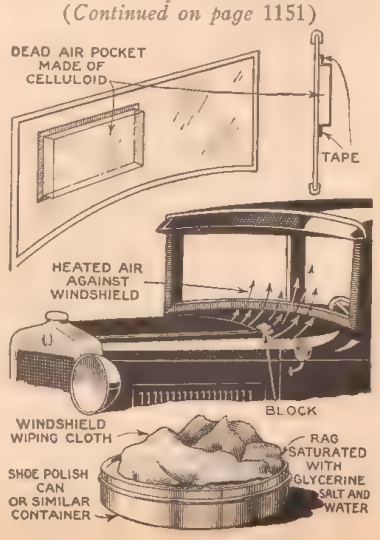
Broken bearings in any of the wheels or in the differential, causing considerable drag.

When the closed car door sags or binds it will be found difficult to close or keep closed. The original cause of the sagging may be traced to a violent opening swing, breakage of the bumper strap, or striking the door against a post when the car was driven. To test for binding it is possible to use a piece of paper, passing this around the closed door. There should be clearance at all positions, except where the rubber bumpers contact. If the sag is found at one position, the obvious remedy is to bend the nearest hinge or to thrust the door away from that point.

To close the hinge, a piece of metal should be inserted between the sides or butts. Pushing the door closed presses the butts closer. If the sides of the hinges are too close, it is possible to open them by inserting a block or spacer on the outside, as illustrated, and forcing the door back. Once the door is straightened in the frame, rattles and squeaks can be eliminated by renewal of the inserted rubber segments, which are inexpensive parts.

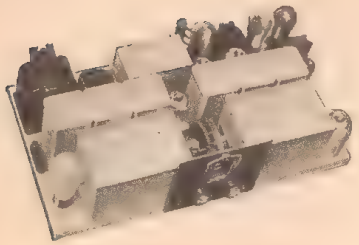
While everyone is concerned with means and methods of handling split rims, and tools are procurable for this use, the homemade, cheap tool will meet the needs of many who desire to econo-

(*Continued on page* 1151)


DEAD AIR POCKET MADE OF CELLULOID
TAPE
HEATED AIR AGAINST WINDSHIELD
BLOCK
WINDSHIELD WIPING CLOTH
SHOE POLISH CAN OR SIMILAR CONTAINER
RAG SATURATED WITH GLYCERINE SALT AND WATER

Three methods of keeping your windshield free of frost, rain, and sleet on these cold Spring mornings—all easy to employ.

What's New in Radio

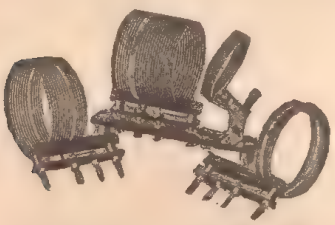


New Hammarlund Products

THE vacuum tube has been countless times referred to as a true "Aladdin's lamp." No type receiving tube, however, is more symbolic of this familiar bottle of magic, than the screen-grid tube.

Especially is this tube an outstanding component, when utilized in dextrously engineered circuits, circuits which capitalize on its countless remarkable properties. Used thusly, titanic amplification throughout the entire broadcast spectrum, with an uncanny vividness of reproduction and correspondingly absence of instability or background noises, is obtainable.

A most unusual circuit, affording such colorful reception, has just been



New Hammarlund short-wave coils.

developed in the laboratories of the Hammarlund Manufacturing Company, in New York City.

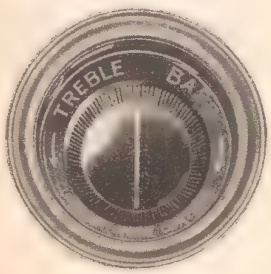
The use of this tube in a unique way as a detector to afford extreme volume on ultra weak signals and with an exceptional trueness of reproduction, is one of the many new and salient developments blended into this circuit, which in turn has been incorporated into a special receiver, known as the HiQ-31.

Another feature is a new "band filter" and radio frequency unit, each having three tuned stages, the "band filter" using no tubes, and the radio frequency amplifier using screen-grid tubes. These components use a special capacitative-inductive tuning and equalizing method, affording extremely keen tuning, yet with no distortion effects.

Using a stage of resistance coupled audio and a pair of –45 tubes, the uniform amplification afforded is tremendous, it being more than 5000 milliwatts.

Tone Control for Every Radio Set

THAT outstanding feature of 1930 radio sets, the tone control, is now made available to owners of any and all radio sets irrespective of type or vintage. In the Clarostat Tone Control, there is provided a universal device applicable to a radio set by the simple expedient of slipping the disc connectors around the prongs of both power tubes in the push-pull type, or around the prongs of the power tube and connecting the other lead with the ground binding post. The device is in the form of a neat case with felt bottom, for use on any table or on top of the set cabinet, together with two long flexible leads terminating in the connectors, so that no tools or special knowledge are necessary for installation. A knob turns from the "Treble" to the "Bass" positions, providing any degree of sharpness or mellowness desired.



New Hand Microphone

THE Kellogg Switchboard and Supply Company has recently placed on the market several new products designed for radio broadcasting, home recording, experimenting, and amateur work. Among these items are a new hand microphone and a modulating transformer which are of special interest. The new microphone is only 6½ inches in length, small enough to be hidden in the hand, and weighs about 10 ounces. It can be slipped into the pocket easily when it is necessary to carry it. Yet, despite its small size, it is sturdily constructed and reproduces throughout the entire musical scale with the utmost fidelity.

The handle is cast from aluminum with a case of formed brass, combining lightness and strength in its construction. The back and stretching ring are accurately machined from the finest grade of alloy steel. The diaphragm is made from the best phosphor bronze obtainable. This is the most vital part of a microphone, and Kellogg engineers have made certain of its functioning properly by gold plating the diaphragm to ensure a perfect contact.

Universal High-Voltage Testing Set

A HIGHLY accurate testing set of unusually flexible design is found in the AmerTran Type TS-15A which has just been announced. This apparatus is ideally suited for light testing in either the factory or laboratory where potentials from 500 to 20,000 volts at 1 kva. are required. It is being used successfully in making accurate dielectric strength measurements on materials such as paper, tape, compound, varnished cambric, condensers, and insulation in small apparatus.

The new AmerTran testing set operates from standard 110-volt, 60-cycle circuits and contains a special air-cooled testing transformer with a four-section secondary winding which permits of obtaining three different voltages at full output—5,000, 10,000 and 20,000. In addition the equipment includes a wire-wound potentiometer for adjusting the voltage to any value between zero and maximum, the exact value being indicated at all times by a precision double-range voltmeter connected to a special winding on the transformer. For protection against damage due to overload a quick-acting circuit breaker is provided.

The new Kellogg hand microphone.

For the Home Machinist

This Month's Installment Features Regrinding Tools, Cutting Threads with Gearless Lathes, Clamps for Securing Work, Hollow Tool Heads, and Boring Implements

By George A. Luers

Supervisor of Ordnance Design, Naval Gun Factory, Washington, D. C.

WHEN a tool is used infrequently, continued regrinding is not necessary. But it is important in making up machine tools to consider the regrinding of the cutting edges of tools you use constantly. A big item is the cost of the tool steel used for cutting edges. A tool and shank of tool steel are expensive; if the tool point is of tool steel and the shank is of carbon steel, a saving is effected. In Figure 1, examples for comparison are shown. The cutting off tool (of the upper view) made with a tool steel blade, will last in definitely. So will the thread cutting tool shown at the bottom of the illustration—the built up cutter. Advantages in sharpening, long life, and small amount of tool steel required for these built up tools are readily apparent.

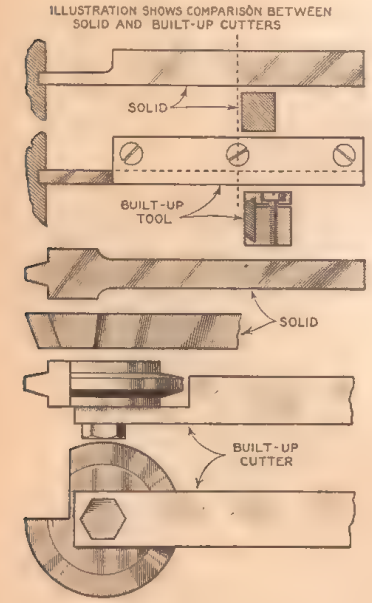


Fig. 1—Tools fashioned completely of tool steel are expensive; why not make your own cutting implements, using a carbon steel shank, and tool steel for the point?

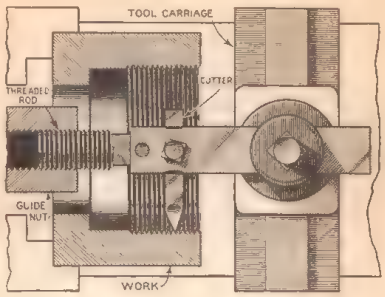
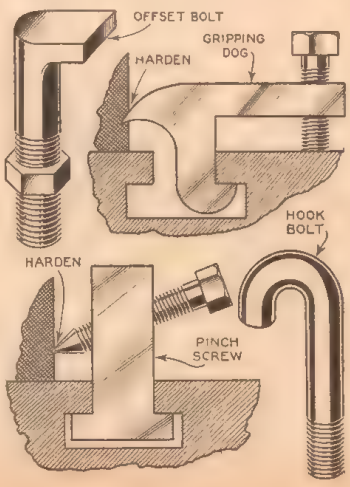


Fig. 2—In cutting threads on a gearless lathe, if this method is employed, the feeding of the tool will be accurate.

In the small shop, a job that is occasionally required is cutting a special thread that cannot be set up with the gears provided, or cutting it on a lathe which is not provided with gears for screw cutting. A serviceable method of accomplishing this is detailed in Figure 2.

A nut, having the required pitch of thread, is secured to the lathe face plate along with the job. A threading tool is provided with a thread rod to fit the nut. It is made solid with the tool, so that rotation of the lathe will move the tool along. The cutter will chase a thread of the same pitch, regardless of the diameter of the work. The nut, of course, must be secure and the threaded rod fixed in the tool. The feeding of the tool will be accurate, as the nut and threaded rod advance the cutter to an exact corresponding pitch.

Fig. 3—These clamps are particularly adapted for working with small machines. You will prefer them to the usual U-clamps.



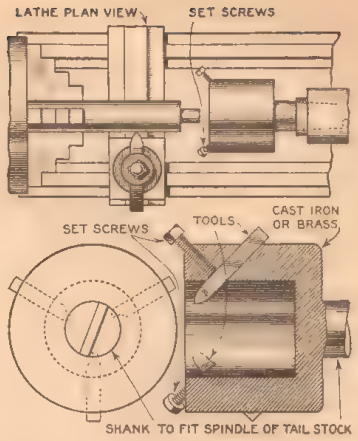


Fig. 4—How the hollow tool head can be adjusted to accommodate three cutters and supplement the tool post.

One difficult problem in machine shop work is that of securing parts firmly against the machine to prevent movement when a cut is taken. U-shaped clamps, with bolts, usually serve excellently. But where these cannot be used, it is a problem to find suitable clamps. In Figure 3 are shown four such clamps, especially good in working with small machines.

The offset bolt can be used when the bolt passes through the bed plate and the nut can be made secure. The hook bolt has the same advantages, and it is cheaper as it's made from round bar stock. The gripping dog is held at one end by the T-slot of the machine bed, and the set screw pushes the edge into the side of the job; the pinch screw holder is similar in application. The pointed screw grips the work. Both of these clamps are of special service on a

(*Continued on page* 1147)

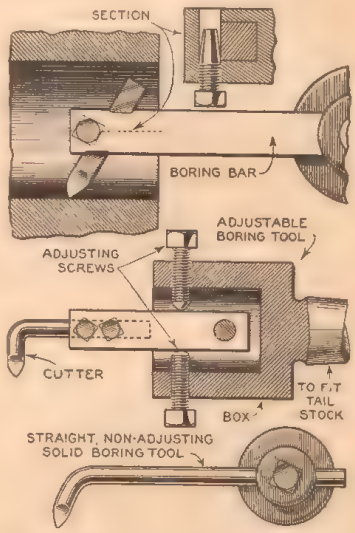


Fig. 5—Correct procedure for a deep cutting job, for a recessed cut, and for boring small holes of limited depth.

How You Can Photograph the Stars

By Dr. Donald H. Menzel
Lick Observatory, Mount Hamilton, California

"HOW can I take pictures of the stars?" is a question that the amateur astronomer often asks. Most people have the notion that there is something mysterious and incomprehensible about the process—that certain peculiar high-powered lenses are required. Not at all. Actually, it is as simple as photographing a tree or an automobile. Any one who has any kind of a camera can do it.

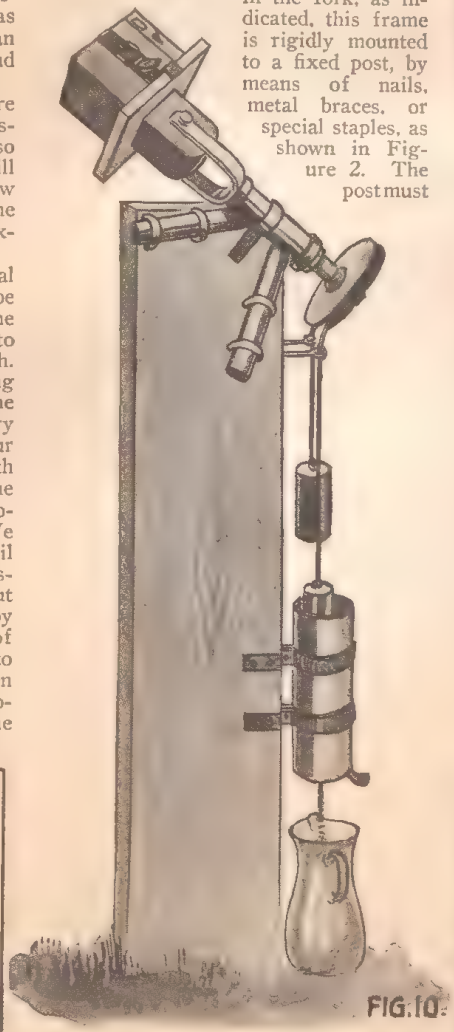
There is one difficulty. The stars are so faint that time exposures are necessary and, of course, either the object so photographed must stand perfectly still or the camera must be turned to follow the motion. One cannot say to the stars, "Hold it, please," while he exposes the plate.

The revolution of the great celestial sphere in which the stars appear to be set is due to the Earth's rotation. The axis upon which the heavens seem to turn is, of course, the axis of the Earth. Our problem, therefore, of designing some sort of mechanism to follow the motion of the stars would be very simply solved if we could fix our camera to the axis and let it turn with the stars, just as a camera nailed to the hub of a wheel would always point toward the same place on the rim. We would find it rather impractical to nail our telescope to an imaginary axis passing through the center of the earth, but we can accomplish the desired result by setting up an axis parallel to that of the earth and fixing our telescope to that. The space of 4000 miles between the true and our artificial axis of rotation is of no consequence since the stars are so tremendously distant.

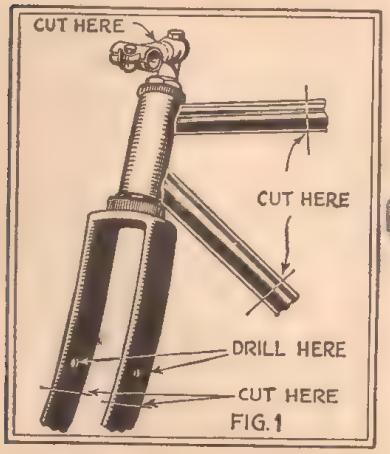
An ideal support for a celestial camera can be made from an old bicycle frame. The handle-bars are removed and the frame cut with a hack-saw as shown in Figure 1. After drilling holes in the fork, as indicated, this frame is rigidly mounted to a fixed post, by means of nails, metal braces, or special staples, as shown in Figure 2. The post must be accurately oriented so that the axis of the instrument points toward the *true* (as distinguished from *magnetic*) north and the angle A must be made equal to the latitude of the place of observation. The direction of true north is most easily found by observing the position of the North Star when Mizar, the star at the bend of the handle of the Big Dipper, is either directly above or directly below the North Star (Figure 3). If the latter were located exactly at the true axis, as is commonly believed, this special precaution would not have to be taken, since Polaris would then remain stationary.

To adjust the slope of the "polar axis" of the mounting to the latitude of the observer, the following method is recommended. An approximate setting can be made by sighting along the axis at the pole star. A right triangle, with one angle equal to the latitude, is sawed out of wood. The latitude can be found with sufficient accuracy from a map and the angle can be drawn with the aid of a protractor. This triangle is placed upon the steering axis and carefully levelled as shown in Figure 2. Be sure to put the angle A at the top. These adjustments may be facilitated if six inches or so of the top of the post is sawed squarely off and then held in its original (*Continued on page* 1122)

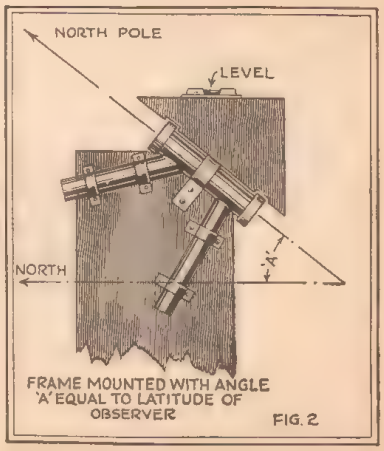
The constellation of Orion, as photographed with a camera having a focal length of six inches.



The complete apparatus in operation.



Showing how part of an old bicycle frame can be utilized.



How to mount and adjust the axis of the camera support.

A Jig Saw for Your Workshop

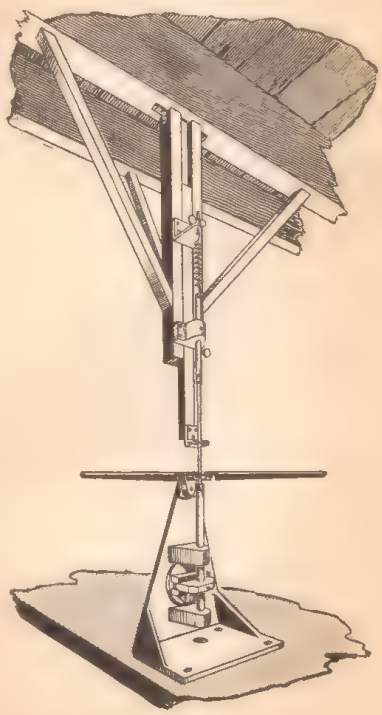
A Few Simple Patterns, Easily Made, Will Permit Your Foundryman to Make the Castings Needed in the Construction of This Jig Saw

By Lester A. Burton

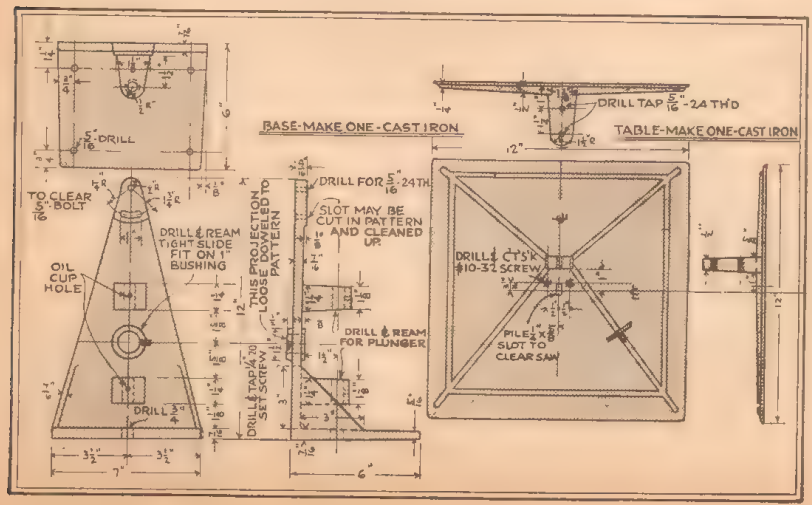
THE need for a jig saw that can cut something besides quarter inch stock with some pep has been felt in our home workshop for a long time and the desire only needs to fester awhile and we get busy. The result was so far past our expectations that we would like others to have one. Here it is.

Since we wanted a substantial affair, cast iron was the material called upon and patterns were made. Pattern making is an art in some respects but we need not worry about it. All that is really necessary is to work fairly accurately and neatly. In regular pattern work shrinkage is taken into consideration and a special rule used to work with. In our drawings allowances have been made to take care of all shrinkage, so we need only work to dimensions, and a little deviation in them will not harm. This applies to the patterns, of course.

In the detail drawings are shown the various parts, so let's get started on the table. Using a piece of ¼" pine or plywood, we set the main projection at the proper location and then lay the ribs. Note particularly the taper or "draft" on the edges of the panel and the ribs. This is necessary, to enable the moulder to draw the pattern from the sand. There are no holes put in the pattern, since they will be drilled afterwards. The next piece in order is the base. Start with a piece of 7/16" pine



A variation of the jig saw described in the text. Below—Details of the castings of the base and table.


BASE-MAKE ONE-CAST IRON
TABLE-MAKE ONE-CAST IRON
DRILL TAP 5/16"-24 TH'D
DRILL FOR 5/16"-24TH
SLOT MAY BE CUT IN PATTERN AND CLEANED UP
TO CLEAR 5/16" BOLT
DRILL & REAM TIGHT SLIDE FIT ON 1" BUSHING
OIL CUP HOLE
THIS PROJECTION LOOSE-USED TO SET PATTERN
DRILL & REAM FOR PLUNGER
DRILL & TAP 4-40 TO SET SCREW
DRILL & C'T'S'K #10-32 SCREW
PILE 1/4" X 3/8" SLOT TO CLEAR SAW
DRILL 3/4"

Set-up of the completed jig saw.

and lay out the shape of the back with a sharp pencil, marking the center line on both sides. Draw rectangles and circles where the different pads or projections occur. Then make the bottom paying attention to the draft indicated. Get the angular shaped ribs ready and assemble these three pieces together, using nails and glue. Next, the pad at the top, cut from ⅛" pine, is glued on, the other pieces being added in the same way. To save labor later the arc shaped opening on the top pad may be cut through the pattern. Make sure you have the draft the right way. It should slope the same as the edges. The pad on the rear of the base must only be doweled to the pattern and be removable. Driving a ten penny nail into the pad and boring a hole in the pattern will serve nicely for so small a part and if put on the centers of each piece, only one is necessary. The nail projects 3/16" on the pad. The small parts, such as the guides, bearing and yoke may be cut from steel or iron if equipment is available. However, as it is not necessary to finish all the surfaces, considerable work will be saved by having them cast. Since they are fairly small no attention need be given the draft, but the patterns are made to dimension with square edges. There are no holes in any of the small patterns and in making the yoke, omit the slot from the pattern.

Sand all the patterns very carefully and give them each a coat of thin shellac. Regular five pound shellac cut in half will fill the bill. Allow them to dry for several hours, sand well with 4/0 sandpaper; apply a second coat. When this is thoroughly dry, sand them again until all rough surfaces disappear.

(*Continued on page* 1130)

Prize Puzzles to Polish Your Wits

By Sam Loyd

THE Puzzle King presents the sixteenth of a series of problems, the solving of which will show if your mathematical ability is bolstered up by logical reasoning. Prize winners of the January puzzles and solutions will be found on page 1142

A FIRST PRIZE of $10 will be awarded to the person sending correct answers to the three puzzles, accompanied by the best expressed analysis of Buffalo Bill's Ride.

A SECOND PRIZE of $5 will be awarded for the next best analysis and correct answers to the three puzzles.

TEN PRIZES of $1 each will be awarded to the ten persons who send the next best analyses of Buffalo Bill's Ride, together with correct answers to the puzzles.

Answers must be received not later than noon, April 15, addressed to "Puzzle Editor," SCIENCE AND INVENTION, 381 Fourth Avenue, New York City.

All contestants must abide by the decisions of Sam Loyd, who will examine all papers and award the prizes.

Papers of identical merit, tying for any one of the prizes, will each receive the full amount of the prize tied for.

Buffalo Bill's Ride

DID you ever hear of that famous 24-hour ride by Buffalo Bill in the old days when he was scouting for General Miles? It was by no means a record for a day's journey in the saddle, but a great feat when the character of the country is considered, and the fact that he was dodging hostile Indians all the way.

The General's cavalry was strung out for thirty miles when Bill was ordered from the tail-end to carry a message to the General at the head of his troops.

Bill delivered his message and returned to the end of the line in exactly the time it took the troops to go forward thirty miles, so you can see that Bill didn't loaf any.

It is said that Buffalo Bill was never able to figure out exactly how far he rode on that memorable gallop, so let us clear up the moot point of how many miles he must have covered in delivering his message and returning to the rear.

Dissecting the Clock Dial

HERE is a proposition that will appeal to those of our puzzlers who like to exercise their ingenuity rather than their mathematics.

In diagram No. 1 it will be seen how the dial divides into halves which contain numbers adding up the same total.

Just as readily we may separate the face into three parts, each containing numbers which produce a common total, as in diagram 2.

In diagram No. 3, we find how a division into four parts, each with the same value in numbers, may be attained through the device of splitting the figure IX into 1 and X, thus increasing the sum total of figures to 80, a number divisible by 4.

The next step in the progression presents our problem:

How would you divide dial No. 4 into five parts, each part to contain the same total of numbers?

The Clock Race

ONE morning my two clocks started a race. The alarm clock became excited and went so fast that it gained one minute per hour on regular time, while grandfather's clock hobbled along so slowly that it lost two minutes per hour on regular time. The race ended on the day following, when the alarm clock struck eight simultaneously with grandfather's clock striking seven. At what time that morning did the race start?

This Department Is Conducted By and For You. Expressions of Opinion or Comments Are Welcome. Please Address Them to Safety Valve Editor in care of this publication.

For Mathematics Department

I AM with C. H. Chittenden for a Mathematical Department. This department, I believe, would be of much interest to your readers, for it is safe to assume that at least 99 per cent. of them are mathematically inclined. Yes, among other features, it should include short cuts and mathematical oddities.

The problem presented by C. H. Chittenden, p. 868, February 1931 SCIENCE & INVENTION is not a curiosity; neither is it a mathematical oddity nor a paradox. The area of the new rectangle is not 144, but 12 (11 + X), where X is the base of the triangular piece formed by the diagonal, the altitude and the base, produced, of the original rectangle. Whoever tries to assume that X = 1 just because the altitude of the miniature triangle is 1 deserves to be hanged. On the face of it, one with but a little mathematical equipment can tell at a glance that X is not equal to 1, for the original rectangle was not a regular polygon. From the condition of the problem, $X = \frac{11}{13}$. The new rectangle is, therefore, $12 \times 11\frac{11}{13}$, with area $142\frac{2}{13}$. Add to this the combined area $\frac{11}{13}$ of the two triangles cut off, and you will again have 143.

This area, 143 sq. in., or any given area, may assume any shape. Let it assume a star shape, if necessary; or the irregular shape of the craters on the moon. Or, one may cut it into strips and lay them end to end, thus forming a figure with perimeter many times the original perimeter; but, assuming no loss in the cutting and assuming, further, the pieces to be rigid, he will always have the same area as there was to begin with. The moment he puts a piece, however small, into his pocket the resulting polygon will, believe it or not, NEVER make 143 sq. in. again. The idea of rearranging the elements that make up a polygon, and throwing away an element or two in order to obtain a polygon of large area is obviously a hallucination.

Let us have a Mathematical Department. Let it include, too, something of a more interesting and useful nature. Let it include the greatest problems of history, and how they were solved. Let it include what is new in mathematics. For instance, the problem of showing that the equation $X^n + Y^n = Z^n$, where X, Y and Z are to be integers, is impossible when n is an integer greater than 2 has stood unsolved for three hundred years. The moment a man comes along with a solution for it, please publish it for us.

I am contented with the magazine as it is, but should there be any changes, I hope it would be for mathematics, physics, chemistry and astronomy. They are indispensable for a magazine like SCIENCE & INVENTION.

M. C. LEDESMA,
School of Engineering of Milwaukee,
Milwaukee, Wisc.

Against Mathematics Department

I NOTICED that in the February issue of SCIENCE & INVENTION, Mr C. H. Chittenden suggested in the Safety Valve that you conduct a Mathematics Department. You asked for opinions from your readers. Well, I think and believe, that most other subscribers will agree with me, that mathematics in this magazine would be a bore. Mathematics is all right for finding the width of a ditch or for finding X^2 when Y^2 is known etc., etc. But it has no place whatsoever in a science magazine. By all means do not run a Mathematics Department, but, instead, use this valuable space for more chemistry, biology or electricity.

HERBERT PATRIE.
Dayton, Ohio.

(We also wish to acknowledge letters from Stewart Huey, Waterbury, Conn.; Norman W. Cote, Waterbury, Conn.; E. B. Mathers, Ventura, California; Jack Weaver, Kerrville, Texas; Edward B. Escott, Oak Park, Ill.; Raymond Petersen, Hartford, Conn.; Hugh Jones, Jr., Clayton, Mo.; B. J. Kocher, Hepworth, Ont., Can.; Richard P. Lochner, Philadelphia, Pa.—EDITOR.

Brainstorming Philosophers

I HAVE made a study of the history of Philosophy and have always wondered whether or not it can be compatible with Science. As Will Durant says: "Some philosophers seem to have all kinds of wisdom except common sense." I would even make this more general, for outside of Kant and some of the later American philosophers, the whole lot seem to be laboring under some kind of a brainstorm.

Their trouble, as I see it, is trying to prove the obvious. For instance, some of them don't even believe their own senses and try to find reasons to prove that everything in life is a lot of guesswork—that we don't know anything for sure. The study of Metaphysics, closely allied to Philosophy, has for its aim the inquiry into the ultimate reality of matter and mind. If we can't depend on what we see, hear and feel, what then can we base our belief on?

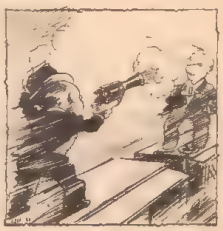
I suppose the usual answer to a criticism of this kind would be that Philosophy is but the beginning of Science. Is it this or is it a handicap to genuine scientific thinking? Can it breed anything but confusion of thought? I would like to know.

CHARLES ROE.
Oskaloosa, Iowa.

(What have some of our budding philosophers got to say about this matter.—EDITOR.)

The Shooting Problem

BEING a reader of your magazine, I read the Safety Valve regularly and find it interesting and educational. I would like to have two questions answered which have puzzled my friend and myself. The solution of these problems would be greatly appreciated.



The first question is: there are two men on the roof of a train. The man on the last car shoots at the man on the first car. The speed of the train is 100 miles per hour, and the speed of the bullet, when it leaves the gun is 100 miles per hour also. The train and the bullet are going in the same direction. Will the bullet hit the man?

The second question is: if a person would jump up in the car of a train, why doesn't the car move away from under him. Would the effect be the same if the man was on the roof of the car?

SAM NARAD.
Niagara, Falls, N. Y.

(These two questions seem to puzzle a great many students. If you will remember that both the gun and the bullet in the gun are already traveling at a speed of 100 miles an hour and that the velocity imparted by the powder is also 100 miles an hour, then the problem becomes very simple. Naturally, the bullet travels with relation to the train at a velocity of 100 miles an hour greater than the train's speed, or with a speed of 200 miles an hour with relation to the earth. If this velocity can be maintained and disregarding air friction, then a bullet fired 100 miles an hour in the same direction toward which the train is proceeding, would strike a man at the forward end of the train.

If the bullet was fired from the rear of the train, it would fall to the ground in a straight line. In this case, the motion of the gun must be subtracted from the velocity imparted by the powder. With relation to the

(Continued on page 1144)

Wrinkles and Recipes

Making Pockets Safe

TO make your pocket a safe place to keep things you carry about with you, cut the zipper of an old pouch or of a discarded overshoe where the zipper is still in working condition and sew it to your side or hip pocket.—*Jacob W. Kehler.*

To Keep Windshield Clear

FROST will not gather on the windshield if a thin coat of glycerine is applied to both sides of the glass. This prevents the formation of moisture. Also try rubbing the glass with an onion.—*Mrs. H. E. Chrisman.*

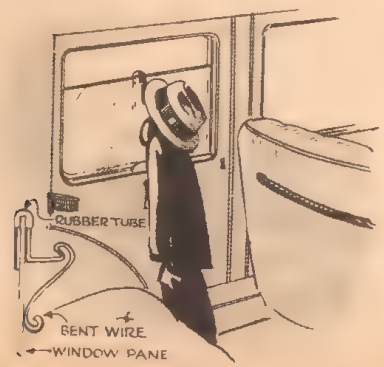
Beautiful Radiator Bronze

A BEAUTIFUL radiator bronze, more attractive than the conventional aluminum or gold bronze, is easily made by mixing both the aluminum and gold powder in equal parts. This combination shows none of the coldness and drabness of the plain aluminum and tones the bright and giddy appearance of the gold. Amateur decorators will find that this novel radiator bronze will blend more harmoniously with home furnishings.—*Earl M. Guild.*

Hang Your Hat in Your Auto

A COAT-AND-HAT hanger suitable for use in any closed car can be easily made. It slips over the top of any window in your automobile.

The device is made of nickel-plated metal. It has a rubber ring at the top, where it rests upon the glass. The back slips over the window, a spring construction keeping it in place. After installation, the window may be opened or closed without disturbing the hanger. —*Gilson Willets.*



For Pressing Clothes

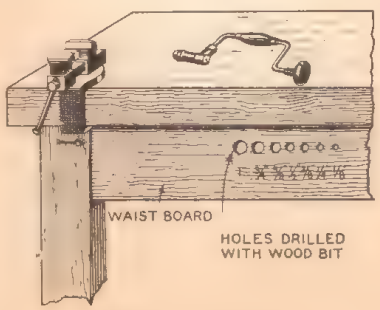
First Prize, $5.00

IT is quite difficult to keep your clothes neatly pressed, particularly when you are traveling. To save tailor bills, try the following method: Put each garment on an individual hanger and hang in the bathroom. Close all the windows and door, turn on the hot water until the whole room is filled with steam. Leave your clothes in as long as you want—for an hour or over night. The clothes will get very damp, so be careful that they do not touch each other or the wall.

Then open the windows and door. When the clothes are thoroughly dry, and not till then, take them down and hang them in your closet, ready to wear. Pleats do not come out in the process, and the writer found it unnecessary to have her clothes pressed for several months. Velvet, silk, felt, wool, jersey, and plush have all been successfully steamed.—*Edna F. Bourjer.*

Which Bit Shall I Use?

BITS are often selected from the rack and used to make a hole in a piece of waste lumber so that the proper size of bit may be chosen. If a hole is bored in the waist board of the work bench with each bit the shop contains, and each hole marked corresponding to the size of the bit, then instant reference may be had at any future time as to the exact size a bit may bore.—*Raymond B. Wailes.*



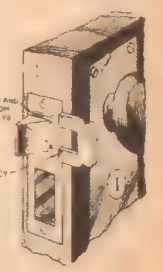
Cleaning Pans

TO make frying pans and steel skillets look like new, boil them in a pan with potato parings and water until the parings are soft. This will remove all accumulations of grease and dirt.—*Mrs. H. E. Chrisman.*

$5.00 is paid each month for the best Wrinkle or Recipe accepted and published in these columns. All others used are paid for at regular rates. Address: Editor, Wrinkles and Recipes.

A Strong Door Lock

HERE is a simple but efficient lock to keep your doors locked. Cut the tongue of your door latch down about ⅛ inch with a hacksaw, both top and bottom. Then cut a strip of brass or other metal to fit these notches, as per illustration. This lock prevents opening the door from the outside.—*L. Churilla.*



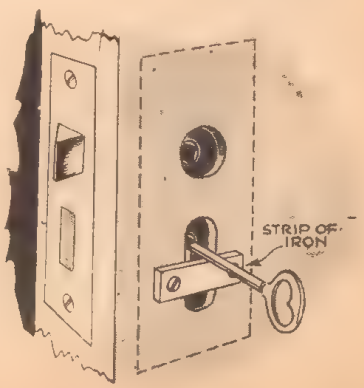
Keep Your Finger Nails Clean

WHEN about to do auto work, if you will scrape your finger nails across the top of a cake of soap, thus filling the space under the nails with soap, you will find that the soap will wash out and there will be practically none of the black grease and dirt stains which are so hard to remove from under the nails.—*T. N. Bates.*

Door Lock Key Retainer

MANY homes have doors equipped with plain mortise locks using bitt keys, which, on inside, rear and side doors are never locked except from one side. The key always remains in the door. These locks usually give trouble either from the key falling out and becoming lost, due to frequent slamming of the door, or the key falling down in the slot in the plate and getting hung. The owner is in constant fear of the lock being picked from the outside by the key's being pushed out.

To remedy these troubles, remove the knobs and inside escutcheon and fasten a piece of sheet iron ¼ inch wide and long enough to cover the keyhole in the door, under the key, with two small screws. Then replace the escutcheon plate and knobs. The key now cannot fall into the slot and get hung nor can it be removed except by taking off the escutcheon plate.—*J. Elton Rogers.*

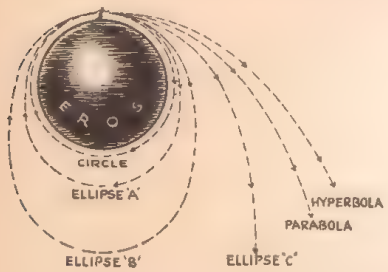


Conducted by
Seymour A. Davidson

Baseball on Eros

(2386) Mr. Sam H. Ralston, Dallas, Texas, writes:

Q. 1. In the March issue of SCIENCE AND INVENTION Dr. Donald H. Menzel in his article "Our Pigmy Planets" states that a ball thrown parallel to Eros's surface with an initial speed of more than 45 and less than 55 miles per hour, by an individual located on the planet, would travel entirely around Eros in about an hour and a half. Not only that, but he goes on to say that if undisturbed, the ball would "continue to circle the planet like a tiny satellite." Will you please tell me what shape the orbit of the ball would assume and explain how the orbit would vary with the speed with which the ball is thrown?



A. 1. The series of possible orbits that the ball might follow are shown in the accompanying illustration. The circular one corresponds to the speed of 40 feet per second. The elliptical ones arise from velocities intermediate between that and the velocity of escape.

A ball projected at 55 feet per second will follow the indicated parabola; at still higher velocities, the orbit will be hyperbolic.

It is true, paradoxical as it may appear, that the faster the man throws the ball the longer it will take for it to return to him. The reason, however, is clear, the faster the ball is thrown, the more elliptical becomes the orbit which it follows. The longer path through which it must travel more than offsets the greater initial and sustained velocity.

Tattoo Marks Removed

(2387) Mr. John L. Young, Cincinnati, Ohio, writes:

Q. 1. Please send me a formula for removing tattoo marks. I received your formula for resilvering mirrors and found it splendid.

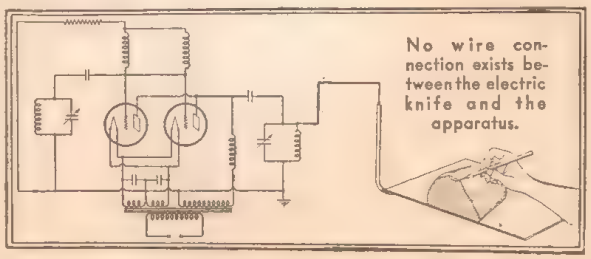
A. 1. There are several preparations which are used to remove tattoo marks from the body. No doubt you have been told that you can use zinc chloride or tannin and silver nitrate. The first process is too dangerous to use and often causes running ulcers. The second method is too harsh. A better means of accomplishing the result which you desire has been suggested by a tattoo artist.

It is an application of a paste made of salicylic acid and glycerine.

It is applied quite heavily to the tattoo and a compress of cotton is applied over the same. The whole is then bound tightly to the part with a bandage, which is removed ten days later. The dead skin is rubbed off with wet absorbent cotton. Antiseptics should then be applied and care must be taken to guard against infection as conditions are excellent for bacterial invasion.

If necessary the paste can be used again. Generally three applications are sufficient. The desirability and practicability of this process lie in the fact that you can stop the action at any time you desire. In the zinc chloride or silver nitrate process, you have to go through with it when once it is started.

In the removal of tattoo marks, no assurance can be given that the resulting scar will look better than the original mark.



Operating by Electricity

(2388) Mr. Robert Saunders, Baltimore, Maryland, writes:

Q. 1. Lately we have been hearing a good deal about the electric cautery knife used in surgery with which it is claimed bloodless operations can be performed. Can you supply me with a diagram of this instrument? Is a real knife employed or is this just a figurative name for an electrode?

A. 1. It is a well known fact that the passage of a high frequency current through the body will produce a heating effect. If the current intensity is increased by making it pass through only a relatively small portion of the subject to be treated, the tissues are cut by a process which seems to be similar to burning. However, when the frequency of the alternating current employed is increased to more than 10,000,000 cycles per second, this tendency to scorch surrounding tissues disappears and with a properly shaped electrode it is possible to obtain a narrow, well defined cut.

The apparatus shown, recently patented by F. C. Wappler, is considered a distinct improvement. Among the advantages claimed is the fact that there is no drag on the cutting device which the operator wields, as absolutely no physical connection exists between this instrument and the apparatus itself.

One side of the circuit is grounded. The other is connected to a large electrode on which the patient rests. This electrode must be insulated from the ground and make good contact with the subject. The surgeon holds the knife or cutting electrode much as he would the usual scalpel. The return circuit is established through this instrument and the operator's body to the ground.

The "knife" is merely a sharp pointed electrode which is fitted with a convenient handle.

The Sidereal or Synodic Month

(2389) Mr. Robert L. Kane, Jr., Savannah, Georgia, writes:

Q. 1. The article "Wonders of the Moon" which I read in the February issue of SCIENCE AND INVENTION contains the remark that the moon revolves around the earth once every 27 1/3 days, i.e., about once a month.

I have tried to compare this with the calendar, but the figures don't agree. Searching further to justify the magazine, I find that 29 days, 12 hours, 44 minutes and 2 and 7/10 seconds is the time it takes the moon to revolve around the earth. Will you please comment?

A. 1. The answer to the question which you have raised depends solely on the definition of the word month. To be more specific Dr. Menzel is correct because he assumes as do all astronomers that he is concerned in this case only with the sidereal month.

The sidereal month is the time it

(*Continued on page* 1147)

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NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

Perpetual Motion Water Wheel

(1254) Orion Larson, Denver, Colo., writes: "I would like to get your advice on a water wheel that would run continuously on the same water after it is once filled up. Or is there such an invention now patented?

"I have one that will run on the same water after it has been filled up, do you see any practical use for it?"

A. Such an invention should be worthwhile, provided that it does what you claim for it. We doubt very much that your system will do so, and unless we misunderstand your communication, we believe that your device smacks of perpetual motion. As you undoubtedly know, we have a standing offer for the mere demonstration of such a method.

We would suggest that you acquaint yourself with the rules of this contest. Your device must not, however, work on the principle of evaporation, atmospheric temperature changes or atmospheric humidity variations and others outlined.

Mechanical Apparatus for Window Displays

(1255) Joseph B. Mahon, Pittsburgh, Pa., writes whether we think it worth while to devote some time and attention to mechanical dolls and mechanical apparatus intended for display purpose.

A. Your plan does not seem to have any basic foundation. Were you in a position to design or develop a mechanical device or mechanical doll that is unique in construction or that portrays, to the point of getting attention, the commodity or article for which it is intended, we certainly would suggest further action.

You do not seem to have any fixed plan of what the nature of the construction would be nor the field for which this is intended.

We would advise that you design several different styles of advertising novelties, try them out in model form and if they are attention-getters, that you protect the best of them with patents and manufacture them until such time as you can turn over the entire production to a responsible organization. Your letter indicates that you have plenty of tools and that you can easily do this work yourself.

Electric Lamp Socket

(1256) J. D. Lawrence, Philadelphia, Pa., has designed a new type of socket for electric lights which he claims to be superior to any existing type. He requests our opinion.

A. In England the Edison base is not used in lamp sockets. There, the bayonet base is in vogue. In this country, many sockets have been patented which are superior to existing types, as you have undoubtedly discovered in your patent search. Even assuming that your socket is designed to be superior to any of those now found or invented to date, what are you going to do with the idea after you have it patented? Unless it fits the standard Edison screw plug which is now found on electric lights, you will also have to go into the business of manufacturing lamps to fit your socket. Changing present styles of lamps would entail considerable hardship amongst consumers and might necessitate a complete change involving hundreds of thousands of dollars in home and office fixtures.

We believe that in a business as well established as this, you can make no radical departures regardless of how beneficial the improvements may be.

A Fuse Blow-Out Indicator

(1257) Mr. Wm. Edwards Brown, Pewaukee, Wisconsin, has submitted an idea for a fuse and signal light which will indicate by means of luminous indicator which fuse has blown.

A. This suggestion is not without merit. Unfortunately, it is too expensive to combine into fuses and would therefore bring the cost of the fuse up 10 to 15 times what it is at present. The system as outlined in your adapter is unique, the first cost being the only cost. There is one objection to the method outlined and that is that the circuit must be complete or closed at the time and after the fuse has blown. Should a socket be temporarily short-circuited, the visual indicator will light only as long as the short persists on the line or as long as the switches to the various conveniences are closed. You may also run into another difficulty in that the visual indicator which you intend to employ has a tendency to light even when connected to one side of the circuit.

The idea in our opinion is worthy of further careful investigation. We would suggest that you do some experimental work and that you also have a patent search made to determine the possibility of broad protection.

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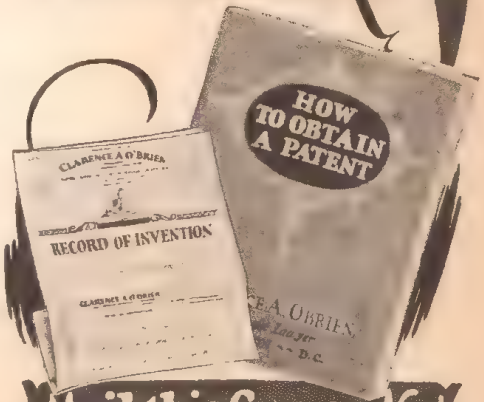

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Among the Inventors

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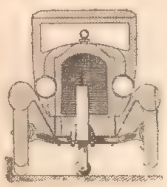
Car Parking Mechanism

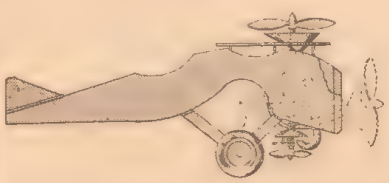
HOW often have you parked your car at the curbside of an empty thoroughfare and returned a few hours later to find a line of cars both in front and in back of your bus? Usually these autos are so closely packed together that it's impossible for you to move out of line. And how often have you wished that you could run your car sideways—only a few feet—in order to gain clearance?

The United States Patent Office has just granted a patent No. 1,778,656 to A. W. Allhoff for a device which should do the trick. Essentially it comprises a fifth wheel which is mounted between the two front wheels. Its axle is at right angles to that of the steering wheels. In operation, a jacklike arrangement, raises the front of the car upon this wheel. When power is applied, the front of the car swings to the right or left as desired, the rear wheels acting as a pivot.

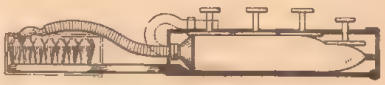


Helicopter—Airplane

THE airplane has speed. The helicopter can rise and descend with a limited area. Any flying machine which embodies both of these desirable characteristics is undoubtedly worth while. One of our clear thinking inventors thinks he has found a way in which he can change over his airplane into a helicopter and reverse this procedure as necessary. In this way, he is able to adapt one power plant so that it can be used in various ways. As our illustration shows, he has both a tractor and pusher propeller attached to his engine. When employed as is customary in the usual type of aircraft, this makes a very efficient



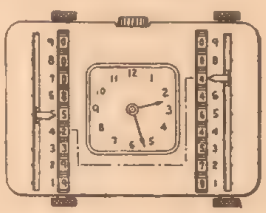
unit. When the entire driving mechanism is turned through 90 degrees both propellers, one on top and one at the bottom of the plane, are intended to provide a lifting force. The patent is No. 1,781,371, filed by C. P. Delo.



Toothbrush Holds Dentifrice

AMERICA is toothbrush and toothpaste conscious. Over the radio every evening can be heard the latest reports concerning a well-known dentifrice, street car ads blatantly advise brushes with various grades of bristles; wherever we go we see smiling, white-toothed persons contrasted with dingy, sad looking, yellow toothed, individuals.

In the face of all these reminders you just can't neglect your teeth. And now to make it easier for you to give your ivories the attention and care which they properly require, Ralph G. Hawksley has designed a toothbrush which has space within the handle for a tube of paste. All you have to do is press a button on the handle and the dentifrice is expelled upon the brush through a flexible hose connection. He does not tell us how he prevents the paste from drying up in the tube or comment upon the difficulty of manipulating the hose. A cover is placed over the bristles, ostensibly, for sanitary purposes. The patent number is 1,776,808.



Combination Wrist Watch and Golf Score

A GOLF score which enables you to record the number of strokes which are required to complete each individual hole over an eighteen-hole golf course has been incorporated with a wrist watch.

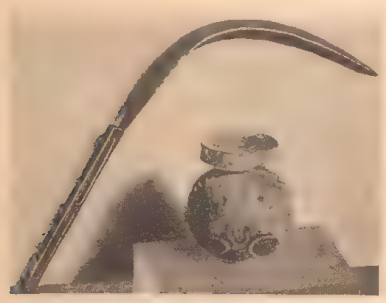
The usual timepiece has been provided on both right and left hand sides of the clock face with a column of figures ranging from one to nine. These numbers represent the holes to be played. A space opposite each hole number is occupied by the figure designating the number of strokes used for that hole. These last named figures are variable and by proper manipulation any number from one to nine can be brought into this position. This patent No. 1,775,066 has been issued to Adolph Bulova.

Forerunner of Modern Sport

(*Continued from page* 1076)

tennis to death. A score or two of players lined up on each side, after being definitely matched in pairs, to insure that the resulting fracas would be one grand mess of fights. Then a ball was tossed, and each individual, in spite of his opponent's resistance, strove to carry it across a given line. Instead of the "straight-arm" of modern rugby, "butting" was permitted. This consisted of punching your assailant violently in the chest, to keep him from taking the ball.

As long ago as the year 1200 A. D. skaters were observed in London. For skates they wore runners made from the legbones of animals, and their idea of skating was to line up at opposite ends of a pond and travel toward each other for a jolly collision; at the point of which they exchanged compliments with stout oaken staves. When a skater hit the ice in those days, it meant that he had been clouted with great vigor and knocked flat. The development of hockey was a humane move, since it transferred the brunt of the blows to a puck—though, to see some hockey players work, you might not think so.



Massaging iron and oil jar used by fifth century acrobats and wrestlers.

Among the primitive ball games from which have developed hand-ball, tennis, ping-pong, and their national variants, was stool ball. One player seated himself on a stool and tried to strike down or away from the stool a ball pitched at it by his opponent. At first the bare hand was used, then a paddle or racket. Versions of the same idea involve the use of tamborine-like rackets among the Basques, while Spaniards, Italians and other peoples have developed equipment and games of their peculiar own. The violent sport of la crosse, originally played by the Indians of North America, is essentially one of this family of games.

Games innumerable have developed from some unknown simple form of nine-pins. Cloish or kayle-pins was merely a matter of setting up a row of conical objects made of wood, and striving to knock them all down by casting a ball or other throwable article at them. Loggats was the same thing, but the pins were made of bones. The modern game of marbles is on the same principle. So is the game of duck-on-the-rock. So is bowling, where the ball is rolled instead of cast; and bowls, in which no pins are used, but only balls.

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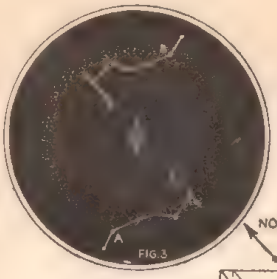
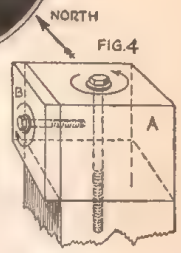
Photographing the Stars

(*Continued from page* 1111)

position by means of a bolt running vertically through its center. This enables one to alter the orientation of the instrument. The angle at A may also be more easily adjusted if the frame is attached, not to the post itself, but to a board which in turn is fixed to the post by a bolt. The form of the arrangement may be seen by referring to Figure 4.



The Big Dipper and the North Star. The true celestial pole is indicated by an X.



Adjustment of the camera is facilitated by providing movable blocks, A and B, which may be rotated about their bolts as axes.

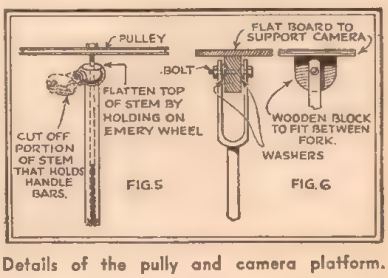
The portion of the stem that holds the handle-bars is also cut off and the top flattened with a file, emery wheel, or, still better, on a lathe. The post can be held in the chuck and the plane of the flat area made accurately perpendicular to the axis of the stem. A pulley wheel, six inches or so in diameter, is constructed of wood or metal, the groove being made deep enough to hold a fairly heavy cord. This wheel is fastened rigidly to the post by means of the regular expansion bolt. (Figure 5.)

A flat board, fixed to a wooden block, Figure 6, and held in the fork by means of a bolt, forms the support for the camera. The nut should be sufficiently tightened to hold the block securely, but it should be loose enough to permit rotation of the block about the bolt as an axis without the exertion of undue force. The aim of this device is to enable one to point the camera at various sections of the sky.

Our next concern is to provide some means of turning the instrument automatically, to follow the motion of the stars across the sky. Various types of clock-work may be devised but the following method is both simple and satisfactory. Two weights, one slightly heavier than the other, are made by pouring melted lead or solder into a tin-can (Figure 7) and later cutting away the mould. Screw-eyes are inserted in the top of the weights, which are then connected by a cord and hung across the pulley, the heavier weight, placed to the westward of the other, rests upon a pile of sand and held in a cylindrical receptacle. A small hole in the bottom of this container allows the sand to leak out and the weight to fall. Metal guides fixed to the post hold the weights in position. The arrangement is shown schematically in Figure 8.

Rating the clock is perhaps the most tedious part of the setting up. It can only be done by trial and error since the rate the sand falls out depends to a large extent upon the nature of the sand. If possible, the finest grade of ocean-sand should be employed. Even the quality of this can be improved by first washing it and then raising it to a bright red heat, which destroys any traces of organic matter it may have contained. Some device for automatically regulating the rate of flow should be provided. In Figure 9, this is accomplished by the aid of the adjustable arm A, the hole in which can be made as nearly coincident as necessary with the hole in the bottom of the cylindrical container. B is a cover to turn off the flow of sand. When the adjustment is correct, A should be fastened rigidly in place. A more uniform rate of flow can be obtained if the inside of the container is made conical rather than cylindrical at the base. In other words, it should be shaped like the neck of an hour-glass. This can be accomplished either by drawing out the metal or by fitting plaster of Paris along the bottom rim inside the cylinder.

The circumference of the pulley wheel should be in the neighborhood of 19 inches. If the maximum fall provided for the weight is 6 inches, the wheel will be rotated through about one-third of a revolution, or about 120°. The rate of flow of the sand should be so adjusted that the wheel would make one complete revolution in 24 hours, i.e., it should turn through 90° in six hours*. By making scratches upon the wheel 90° apart and providing some sort of index, one can judge whether the clock is turning too slow or too fast, and make the necessary adjustments. The final criterion, of course, for accurate setting is the resulting photograph. The completed instrument, with a pitcher to catch the falling sand, is shown in Figure 10. Though the use of a bicycle as a telescope support is not entirely new, the scheme here described has, as far as the author can ascertain, never before been published. The novelty and ease of construction especially recommend it to the amateur



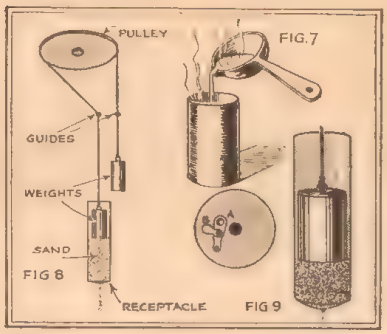
Details of the pully and camera platform.

*Actually, it should be one minute less than six hours, since star-time gains on sun-time at the rate of about four minutes a day.

builder and experimenter.

In conclusion, it seems advisable to say a few words about the choice and operation of the camera. Almost any type of camera can be employed, from the simple "Brownie" to the elaborate Graflex. In every case, the iris diaphragm should be opened just as wide as is consonant with good definition. The "speed" of the camera, then, will depend solely upon the "focal ratio," the focal-length of the camera divided by the diameter of the lens aperture. With the same exposure-time and the same focal ratio, a tiny vest-pocket camera will obtain a picture of the same density as will a much larger camera.

The scale, only, of the latter will be greater, in direct ratio of the focal lengths. Needless to say, "fast" films should be used.



Pouring lead for the weights and adjusting them in the apparatus.

Behind the Scenes of a Nation-wide Broadcast

(*Continued from page* 1078)

the surface and the submerged craft.

The first morning the NBC staff was taken for a trip in the 0-8, the initial submarine experience for all. As she plowed out to the operating area, Deming took us collectively and individually through every part of the ship. The area was not great, but every inch of space was filled, and compactly, with valves, indicators and gadgets of every description. Often we bumped our heads before learning to duck in and out and around like experienced seamen. Questions were asked and promptly answered. But the explanations of the officers, clear and concise no doubt to the Navy, made the problem of presenting this picture by radio apparently hopeless.

Returning to the base, Lieutenant Commander Deming calls a conference and the radio group and Navy executives go into a huddle. A second submarine is suggested for carrying the transmitter. This has little support at first because there is an objection to operating two of these craft so closely together. Argument is met with logic and, shortly, Lieutenant J. W. McColl, Jr., is introduced. He commands, we are told, the flagship of the squadron and his crew was second only to Hern's in volunteering for this assignment.

The two skippers pow-wow a moment or two, make a few rough sketches and, in a united front, tell their superior, Deming, that it will be nothing at all to operate "fifty feet apart," if necessary.

After some delay it is decided that another test will be made the next day and the radio equipment is distributed.

A shore station for receiving and sending is established in a dock house. Grey and Thomson are assigned there and set to for the balance of the afternoon. Brown, Campbell and Peck set up the other transmitter aboard McColl's boat, the 0-4, and appropriate most of the space in the forward battery room, even taking over the skipper's bunk where they locate a short-wave receiver. Meanwhile, Hutson, on the 0-8, is seeking some way of getting the microphone cable into the submarine proper, in the event the tests are successful. Finally, the drain in the galley sink is selected and Hutson's worries appear to be over.

The next day both the 0-8 and 0-4 headed out from the base at the same time. Arriving at the operations area they manoeuvered into position and the retriever, now relegated to a minor rôle, carried a light, eighteen-strand manilla line through the "bull nose" at the bow of the 0-4 and 0-8. With the line secured the two submarines got under way once more on the same course, running parallel and, after an hour or so, the line was still intact. Hauled in, it revealed little wear and Deming gave his consent for the waterproofed microphone cable to be attached to the line.

This was accomplished by the able seamen of the 0-4 and once again the retriever carried the line across to the 0-8.

But now, under way again and, this time, the line, weighted with the cable, drags alarmingly. It is paid out carefully and the two skippers call across the widening span of water, telling their courses so each will adjust accordingly and not snap the line. It holds, and soon Wallington and Ives on the bridge of the 0-4, hear Hicks and Momsen talking on the bridge of the 0-8. Not clear at first, but recognizable.

From below aboard the 0-4, Brown cuts in trying to call Hutson, likewise below in the 0-8. There is no response; something has gone wrong. Is one of the cables cut or perhaps the insulation broken? No, there is Hutson speaking now. The pairs had not been attached correctly and he changed them.

Back from the Base, Thomson and Gray notify Brown that the voices from both subs are heard clearly. The 0-8 is requested to dive. Down she goes, all eyes watching the cable, straining, tugging, twisting through the water. Slight and fragile in a sense,

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but drawn as tight as any violin string and quivering and singing a tone all its own. So great is the drag of water that the two skippers report the bows of their ships are towed in, and they make corrections in their course constantly.

Deming is giving his entire attention to the cable. His eyes are on it intently. Once or twice he calls out sharply, but still it is holding and the voices are coming through.

Now the O-8 is coming up! More strain on the cable but it holds. Completely up now and the cable is cast off by the O-8 and it is reeled in by the O-4. An inspection reveals several broken places and as the boats head back for the Base, the cable is spliced here and there.

Later a dinner is given by the Navy officers and their wives for the visitors. Songs of the service are harmonized and soon one is heard that gives an idea.

Its words are catching and to the point:

"Oh, the battleships are mighty!
They're the backbone of the fleet.
The airplanes and destroyers
Are mighty hard to beat.
The armored cruiser squadrons
Are known o'er land and sea
But any greasy sub-ma-rine
Is home sweet home to me."

What a rollicking tune! Will they repeat it?

They do and with gusto. It rolls easily off the tongue and soon everybody is singing it. Now we are learning the words and thus a theme song for a special broadcast is born.

Saturday morning comes and a dress rehearsal is called. From start to finish we carry on and are twenty-two minutes over the allotted period.

We return to the Base and to New London. More thought and discussion ensue and the story we are trying to tell is compressed, here and there. But still all are worried. It doesn't exactly click. We are too close to the picture we decide, and must gain a perspective. A proposed Sunday morning rehearsal is called off and the submarine is a taboo subject by all hands for twelve hours.

Sunday arrives clear and cold, the best day since our arrival. We leave the Base at 10 o'clock and cruise slowly out to the area. Our station at the Base reports reception is excellent. The cable is carried over by the retriever and made fast to the O-8. The submarines get under way and now a new problem. Sea weed is collecting on the cable and dragging it worse than at any time before.

But it is already 1:15 and we take the air at 1:30. Too late to do anything about it, we must trust our luck.

One twenty-nine.

From the shore station comes a warning.

"Stand by, one minute to go."

Whispers are heard from the bridge of the O-8.

"Cut it, standing by," is hissed from the O-4.

Silence. . . .

Below at the base of the conning tower in the O-4 a sailor drops his arm.

Someone hits Lieutenant McColl's leg and he waves a flag.

From the bridges of the O-4 and O-8 comes in jubilant lusty chorus:

"Oh, the battleships are mighty!"

Commander C. M. Elder, executive officer of the Submarine Base, with Hicks, Momsen and Hern on the O-8 is singing it. Deming, Ives, McColl and Wallington from the O-4 are singing it. And down below at a mixing panel, Stanley Peck is feeding the input from both microphones into the transmitter and in homes across the land it sounds as if all are singing from the same source:

"They're the backbone of the fleet.
The airplanes and destroyers
Are mighty hard to beat.
The armored cruiser squadrons
Are known o'er land and sea
But any greasy sub-ma-rine
Is home sweet home to me."

The program clicked off to stop watch and was just one minute and twenty-two seconds over its scheduled period.

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My Wireless Memories and Inventions

(*Continued from page* 1087)

and found that when the filament was rendered incandescent by a direct current, a galvanometer connected between terminal of the plate and the positive terminal of the filament, indicated a small current, but no current at all was indicated when the galvanometer was inserted between the plate and the negative leg of the filament. Edison, however, never discovered the reason for this effect and made no practical use of it.

He gave some lamps of this kind to the late Sir W. H. Preece and the latter described some experiments with them to the Royal Society, but he, like Edison, found no reasons for the effect.

I followed up the matter between 1884 and 1890 and discovered that the incandescent filament was discharging into the surrounding space particles, which at the time I took to be carbon atoms, charged with negative electricity. We did not at that time know anything about electrons, which were not discovered until about 1897 or '98 by Sir Joseph Thomson.

I found that if a positively charged conductor was connected with the plate, the moment the filament was made incandescent the positive charge was destroyed.

Finally I found that if two carbon horseshoe filaments were sealed into one exhausted glass bulb, then, when the filaments were both cold, an enormous voltage was required between them to create the smallest current. But if one of the filaments was rendered incandescent a D. C. voltage of even 1 volt would transmit a considerable current through the vacuous space, provided the incandescent filament was made the negative electrode.

I made all these discoveries the subject of a Friday Evening discourse at the Royal Institution, London, in February, 1890, and of papers to the Royal Society and Physical Society in 1890 and 1896.

The 25 K.W. alternator (2,000 volts, 50 cycles) used for the first transatlantic radio signals in 1901.

Returning now to the question of Maxwell's electromagnetic waves; although G. F. Fitzgerald had suggested that the oscillatory discharge of a Leyden jar might produce these waves, no one had, until 1887, accomplished the feat. In that year news began to filter through from Germany that Hertz, a favorite pupil of Professor Von Helmholtz of Berlin, had discovered a way of doing it.

Hertz's oscillator or radiator consisted of two metal rods, each with a brass ball at one end and a flat metal plate at the other. The rods were placed in line with the balls, these being separated by a slight distance. When the balls were connected to the secondary terminals of an induction coil and sparks passed across the gap, the oscillator radiated Maxwell's electromagnetic waves. Hertz used as a detector a simple ring of wire with a minute spark gap at one place in it. Nevertheless, with this crude detector he succeeded in showing that the Maxwell waves sent off from his oscillator could be reflected, refracted, polarized and caused to exhibit effects similar to those of light or dark heat waves.

Physicists all over the world then threw themselves enthusiastically into this new field of experiment, and very soon Branly in France and Lodge in England invented the so-called Coherer (made of metal filings) which proved to be a far more sensitive detector of Maxwell's waves than was Hertz's ring.

In 1885 I was appointed Professor of Electrical Engineering in University College, London, a position which I occupied for 42 years, and I had opportunity there for experimental research. I took great interest in Hertz's researches and described them in detail in Volume 1 of my book "The Alternate Current Transformer," published in 1888, and made various experimental appliances for reproducing Hertz's experiments.

Hertz died early in 1894, and in the summer of that year Sir Oliver Lodge gave a memorial lecture at the Royal Institution on the work of Hertz in which he showed remarkable experiments with his coherer in detecting Maxwell's electric waves produced by a distant oscillator. He also gave a similar discourse at the Oxford meeting of the British Association, and showed that a coherer could be influenced by an oscillator at a considerable distance.

Meanwhile, in 1892, Sir William Crookes had written a remarkable magazine article foretelling the coming of a wireless telegraphy based on the little known previous work of D. E. Hughes, the inventor of the microphone.

Also Lodge's lectures had stimulated many minds, and the late Admiral Sir Henry Jackson, R. N., had begun to work at the subject in the interests of British Naval signalling.

Then we began to hear something of the work at Bologna of a young Italian physicist, Guglielmo Marconi, afterwards to become very famous, and in June, 1897, Sir W. H. Preece exhibited and described his apparatus for wireless telegraphy at the Royal Institution. I attended that lecture. My acquaintance with Mr. Marconi began the following year, at Easter time, 1898. Mr. Marconi was then living at Bournemouth,

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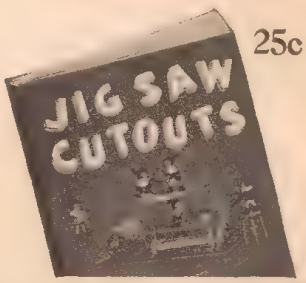

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on the south coast of England, and had erected his wireless station there to communicate with one at Alum Bay in the Isle of Wight. For two years previously he had given demonstrations of his system to the Italian and British Governments. At Bournemouth I asked his permission to see his apparatus and he very kindly invited me to call on him and inspect it. I always remember the great interest which I felt on receiving a Marconi wireless message from Mr. Marconi's assistant, "Compliments to Professor Fleming," transmitted over 12 miles of sea by Maxwell's electromagnetic waves.

The following year he established wireless communication across the English Channel from Wimereux (near Boulogne) to Dover, and this created a great sensation in England. I wrote a letter to *The Times* in April, 1899, emphasizing the great importance of his achievement. In September, 1899, I gave the evening lecture before the British Association meeting at Dover, and Mr. Marconi arranged for me an exhibition of his system of wireless telegraphy to be in operation during the lecture.

He then achieved further successes with it, covering over 100 miles in the autumn of that year, and he resolved to make an attempt at transatlantic wireless telegraphy. Up to that time only laboratory apparatus, such as induction coils and Leyden jars, had been employed, but it was evident that for long distance working it would be necessary to use an engineering plant of great power.

Some seven years previously, in 1892, I had been appointed Scientific Adviser to the London Electric Supply Corporation, formed to undertake electric lighting in London by the late Dr. Ferranti's system of high potential alternating current, and I had become familiar with the subject of transformer working. In 1899 I was appointed a scientific adviser to Marconi's Wireless Telegraph Company.

No one, however, had previously employed such plant for wireless telegraphy, and my first work for the Marconi Company was to transform the physical laboratory apparatus then employed into an engineering plant.

A site for the first long distance radio station was selected by Mr. Marconi in a remote district at Poldhu, on the coast of Cornwall, and I was instructed to specify the engineering plant for the station.

The designs for the first building were drawn on my lecture table at University College, London. I ordered for the work a 32 horsepower oil engine, a 25 kilowatt alternator with a voltage of 2000, and two 10 k.w. transformers to raise the potential to 20,000 volts. This plant was all erected in the building at Poldhu by Mr. R. N. Vyvyan during the years 1900-1901.

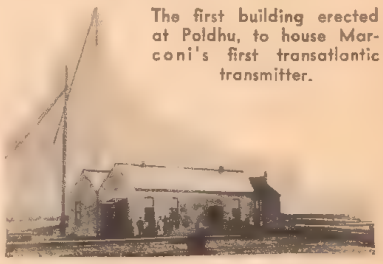
For condensers, in place of Leyden jars, I designed a type consisting of a flat stoneware pot having in it 20 plates of window glass sandwiched with thin zinc plates, alternate zincs being connected together. The pot was filled up with linseed oil. Each had a capacity of about 0.033 microfarad.

Previous to this date Mr. Marconi had patented his tuned transmitter system of wireless telegraphy, in which the discharge of a condenser across a spark gap took place through the primary coil or an oscillation transformer, the secondary circuit of which was inserted between the aerial and the earth plate. These two circuits had to be tuned to resonance.

The control of the oscillations for signalling purposes I achieved by inserting in the alternator circuit one coil of a transformer with an iron core, the secondary circuit of which could be short-circuited at pleasure by a signalling key.

The spark gap gave trouble owing to the tendency of the transformers to establish an electric arc superimposed on the condenser spark, and so prevented a Morse dash signal being made. I devised an air blast arrangement to blow out the arc, but the trouble was finally overcome when Mr. Marconi invented his high speed, studded-disk, rotary discharger.

The tuning of the circuits had at first to be effected by trial and error. One



The first building erected at Poldhu, to house Marconi's first transatlantic transmitter.

evening, walking along the cliffs near by with Mr. Marconi, I suggested to him a plan by which the expansion of a fine wire heated by the aerial current could be made to tell us when the aerial current was at a maximum. I remember we rushed back to the station and had a rough model made at once. It worked all right and was the progenitor of all subsequent aerial ammeters.

In the transmitter as first used I designed a double transformer system in which the voltage of the first oscillation transformer was not put on the aerial, but was used to charge a second set of condensers. The object of this was to secure a very high voltage on the aerial. Meanwhile, Mr. Marconi had erected a circle of 20 wooden masts, each 200 feet high, to support a cone-shaped wire aerial. A storm, however, damaged some of them and the first actual signals sent across the Atlantic (the famous letter S—. . .) were achieved with a smaller aerial.

The double transformation system I had arranged employed 26 condenser boxes (=1.43 mfd.) for the primary capacity, a secondary capacity of .037 mfd., a primary spark gap of 7 milliinches and a secondary gap of .157 inch.

When all was ready Mr. Marconi and two assistants started for Newfoundland with kites and balloons to support a temporary aerial, and on Thursday, December 12th, 1901, he received the "S" signals at St. Johns and cabled the information to England on Sunday, December 15th, and the press announced

the achievement the next day. This success was, however, really due to the then unknown ionized layer of the upper atmosphere, now called the Heaviside layer, by which the waves then used were diffracted around the surface of the earth for 2000 miles.

We knew nothing in those days about the wavelength used, as it was not until 1904 that I invented my cymometer, or wave meter for measuring the length of electric waves.

Turning now to the receiving apparatus, the "S" signals were received by Mr. Marconi with his own and with other types of coherer, but it was not until six months later that he invented his magnetic detector.

However, I was anxious to find some wave detector which would appeal to the eye rather than to the ear, for I had become afflicted with obstinate incurable middle ear deafness and could not well use the magneto telephone as a signal making device. I was familiar with the use of the mirror galvanometer of Lord Kelvin, as used for submarine cable signalling, and I wished to adapt it for wireless signalling. To do this it was necessary to rectify or convert into direct currents the feeble alternating currents in the receiving aerial. After trying some ineffective experiments with electrolytic rectifiers, my old experiments in 1890 with the vacuum tube rectifier occurred to me, and before long I asked my assistant to set up two large square coils which we had, and to create electric oscillations in one coil, and in the other coil circuit to include a mirror galvanometer and also one of the vacuum bulbs I had formerly made which contained a carbon loop filament and a metal plate. When the filament was made incandescent by a battery I knew that the space between filament and plate would convey negative electricity only in one direction.

The matter to be ascertained was, however, whether this would hold good for very high frequency feeble currents. A single experiment proved that it did. Therefore I at once asked the Edison and Swan Electric Light Company to make me a dozen 12 volt carbon filament lamps and to place around each loop filament a metal cylinder connected to a wire sealed through the bulb.

If, then, a mirror galvanometer or telephone had one terminal attached to this cylinder, and the negative end of the filament (made incandescent by a local battery) was connected to another wire and the two placed as a shunt across the condenser of a wireless receiving circuit, this *Valve* as I called it would rectify the alternating current and detect it. Hence was born into the radio world the first thermionic or Fleming valve. The Marconi Company very soon adopted it as a practical detector in their receivers, for it had the advantage of not being upset by "atmospherics" or other violent waves.

My university teaching and consulting work and attention given to other researches prevented me from developing this two-electrode thermionic valve into the amplifier or three-electrode valve as I ought to have done, but I had given a new departure to invention and, in giving Judgment on a petition to extend the British patent, Mr. Justice Sargent said: "I do not think that that valve (the three-electrode) would ever have come into being but for the previous invention of the 1904 Fleming Valve."

It merely remains to add that the decision of His Honor, Judge Mayer, D. J., in September, 1916, in a United States District Court, confirmed later by the unanimous decision of three judges in the United States Court of

Map of the English Channel showing the places at which Marconi's early experiments were made.

Appeals for the Southern district of New York in May 1917, gave an absolute priority to me for the invention of this thermionic valve, both as a detector and producer of oscillations.

As it has been repeatedly stated that the original Fleming two-electrode valves were not highly exhausted but only so-called "soft" valves, and as a claim has been made by Irving Langmuir to have made a patentable improvement by making the vacuum a high one, I should like to point out that in my original patent specifications for this valve the necessity for a high vacuum is clearly stated. In my United States Patent Specification No. 803,684 of April 19th, 1905, for the Thermionic Valve, page 1, lines 96-105, the words are:

"As a very high vacuum should be obtained in the bulb, and as a considerable quantity of air is occluded by the conductors, these should be heated whilst the bulb is being exhausted. The filament can be conveniently heated by passing a current through it, while the cylinder can be heated by surrounding the bulb with a resistance coil through which a current is passed, the whole being enclosed in a box lined with asbestos or the like."

The above paragraph clearly indicates that it was my intention to employ a very high vacuum in the bulb. As a matter of fact some of my early valves were exhausted by the process invented by my friend the late Sir James Dewar, by which the air was absorbed by means of cocoanut charcoal cooled with liquid air, and this process produces the highest possible vacuum. It is not then open to any subsequent inventor to claim as a new invention the making of a very high vacuum in the thermionic valve bulb.

In all its improved forms, with three, four, or five electrodes, or the water-cooled metal bulb valve, the thermionic tube has become the master weapon of the radio engineer, both as a generator and as a detector of oscillations. Without it, there would not, in all probability, have been any wireless telephony or broadcasting.

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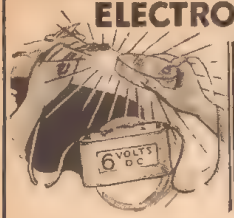

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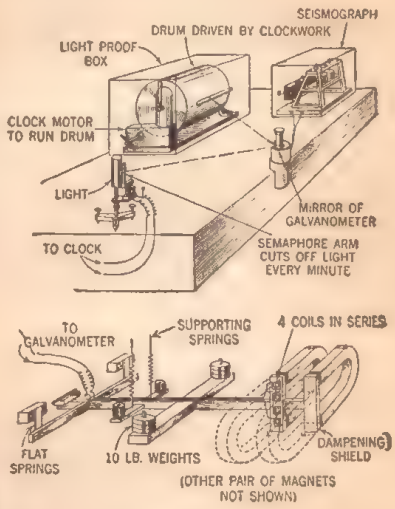
When the Earth Quakes

(*Continued from page* 1071)

fact which was discovered as soon as earthquake waves began to be recorded. It was found that from each quake or shock, not one set of ripples but two distinct sets of ripples were sent out, traveling at different rates, the faster one traveling about five miles a second and the slower one about three miles a second. These waves travel through the earth by the shortest path from the quake to the recording station, *i. e.*, they radiate through the earth to all parts of the surface. The further away an earthquake is from the recording station, the greater will be the time interval elapsing between the arrival of these two waves, and it is this time interval that gives us a clue to the distance of the quake. Given the time of arrival of the first and the second waves at any observatory, the problem reads like an old time problem in pre-Volstead arithmetic.



Details of a seismograph. Movement of the coils in a magnetic field sets up a current and operates the galvanometer.

The time of arrival is recorded automatically on the record by a clock which operates a relay connected with the instrument every minute. From a single record we can determine the distance but not the direction of the quake, but if we have the distance reported from three separate stations we can locate the quake by drawing three circles on the globe with the three stations as centres and their respective distances from the quake as radii. The three circles can only intersect at one point—the centre of the quake. Under certain circumstances, where a station has complete equipment, both distance and direction can be determined from a single station, but the process is more complicated.

A question often asked is "From how great a distance can you record a quake—is there any definite range for earthquake instruments?"

In the neighborhood of an earthquake any instrument will record or receive the shock, but when we come to distances of three or four thousand miles, a moderate shock would only be recorded on a fairly sensitive instrument. The instruments in use today vary in sensitivity or magnification roughly from about 10 to 2,000, *i. e.*, they magnify the motion of the ground from 10 to 2,000 times.

But though a station be equipped with sensitive instruments capable of recording moderate quakes from any part of the world, it may not always be in a position to determine the distance of the quake, due, not to lack of sensitivity on the part of the instruments but to another factor which only became known as the study of seismology progressed. This is the existence of what we might call "blind spots," *i. e.*, places on the earth where earthquake waves even from violent quakes will not penetrate. A station placed in such a blind area will naturally not record the essential phases of the quake. This blind area exists for every quake. It begins at a distance of about 7,000 miles around the circumference of the earth from the the quake, and extends to about 10,000 miles, being a belt around the earth, therefore, of about 3,000 miles in width. In this belt, the two waves we spoke of at the beginning, fail to appear and a station situated in this region, even though equipped with the most sensitive instruments, would fail to record these waves. In fact, it was the failure of well-equipped stations to record these waves when they were recorded by stations with much less sensitive equipment, that led to the discovery of this blind belt.

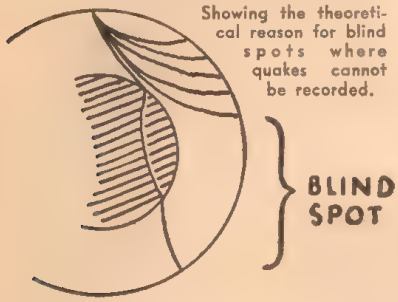
The explanation of the blind area is this. The earth has a dense core which begins about halfway down towards the centre of the earth. When earthquakes waves enter this core they are bent or refracted away from their former path, much as light waves are bent when they enter water. An earthquake wave, then, that normally would be expected to reach the surface about 7,000 miles away from the quake, due to its being bent by the core, will only strike the earth's surface 10,000 miles away. This bending or refracting of waves is quite familiar to us in the case of light. A glass prism in a periscope is used to bend the light rays so that an object can be viewed around corners. The core of the earth acts as a prism and bends earthquake waves in the same manner.

The first or faster wave, after disappearing at a distance of 7,000 miles, reappears with renewed vigor at a distance of 10,000 miles, but the second wave is apparently lost in the core. This leads to the conclusion that the core of the earth is a liquid, or at least possessed of liquid properties.

However, quite recently traces of this secondary wave, as it is called, have been identified after passing through the core, but its appearance is feeble, the bedraggled appearance of the pro-

verbial drowned rat. The fact that it does emerge though, even feebly, leads now to the conclusion that the core of the earth is not liquid as has been hitherto supposed, but solid.

In answer to the question, then, what has seismology so far taught us, we can say that with regard to the earth it has taught us that the earth has a dense core, probably of iron, at a depth of about half its radius, and that Mother Earth is not only "solid to the core" but solid right through the core.



Showing the theoretical reason for blind spots where quakes cannot be recorded.

A third and perhaps as important a wave travels around the surface of the earth instead of through it. Such a surface wave will not experience any blind area, since it does not touch the core. These surface waves are recorded much later than the other two, due to the facts that they have much longer paths to travel and travel more slowly. They travel about two miles a second and are helpful in determining the distance of the quake.

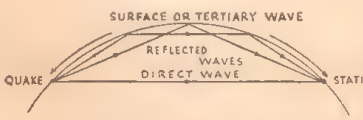
In conclusion, one naturally asks: "What is an earthquake?" It is a sudden movement of a portion of the earth's crust—an attempt to restore equilibrium.

The precise causes of these readjustments are not fully known—there are many contributing causes. It is frequently asked what part atmospheric changes play in causing quakes. They probably play a minor part. A sudden change of atmospheric pressure may frequently be the last straw on the camel's back.

In certain earthquake regions of the world, however, the belief exists locally that there is some connection between earthquakes and the weather. This is particularly so in the Andean region of Argentina and Chile, where the inhabitants become apprehensive at the appearance of what they term "earthquake weather." Preceded usually by a series of severe atmospheric disturbances, such as cyclones and violent electrical storms, an intense, hot calm settles over the foothills of the Andes, accompanied by an extreme heaviness of the air and a weird silence, as if all Nature were brooding over the forthcoming calamity. If night falls before the quake takes place, then, just before the actual occurrence, the conditions are aggravated by an intense and peculiarly opaque darkness. Then there will follow a warning shock, accompanied by subterranean rumblings, and within a few minutes, in the case of a severe earthquake, the main shock will take place, accompanied by thunderous underground crashes. Vast fissures several feet in width and of unknown depth open up in the ground, and frequently, nearby volcanoes commence to erupt more or less violently. Immediately after these Andean earthquakes, torrential rains usually commence to fall, and last for several days.

When the earthquake occurs in the neighborhood of great bodies of water, disastrous water waves may be formed anywhere from a few feet up to 100 feet high, unnoticeable almost on the high seas where they spread out so much, but very noticeable when they pile up on the land. Such a wave was started in recent times by the great Newfoundland quake of November, 1929, which destroyed so many of the transatlantic cables.

Submarine earthquakes take a tremendous toll of the lives of fish, ships frequently reporting that for hours they have sailed through seas strewn thickly with the dead bodies of every variety of marine life. Why are the fish killed? We know that water is incompressible and, because of this fact, that fish can be killed in large quantities by exploding a bomb under water. Evidently, readjustments of the ocean floor take place with a degree of violence resembling a vast submarine explosion, resulting in the deaths of all marine inhabitants for miles around. That a submarine earthquake is often of such violence is borne out by reports of ships which have been in the vicinity. The effect on a ship in such cases is that of a violent blow, as if she had struck some fixed obstruction, and only after soundings have been taken to determine the depth of the water under the ship, and soundings within the ship for evidences of damage and consequent inrush of water, can the captain be sure that he has not struck an uncharted rock or a submerged derelict. Such shocks do no serious damage to a ship, and do not cause her to spring a leak.



The directions taken by quake waves which account for the difference in time of arrival

In other cases when the shock is less violent, or when the ship is some distance from the epicentre, the effect is one of violent vibration, just as if a giant hand had taken hold of the ship to shake the life out of her, as a terrier shakes a rat. This vibration often lasts for many minutes. In such cases, fixtures on board will be displaced which years of buffetings by countless storms have never succeeded in moving.

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A Jig Saw for Your Workshop

(*Continued from page* 1112)

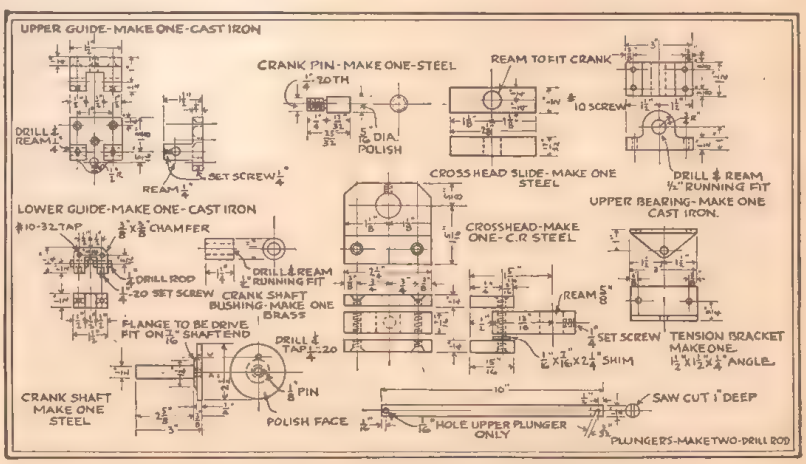
Now, while the castings are being made, let us work on some of the other parts. Drill rod can be bought in most good hardware stores, accurately ground to size, and is the best to use. One stock length of 36″ will be enough. Since the drawings of the plungers are easily understood we need not discuss them. The next and one of the most important pieces is the crank shaft, with its flange and pin. If you are not equipped with a good lathe, have this piece and the bushing made at a machine shop. You can cut the parts of the crosshead yourself and finish them to size. The important dimensions are the distance from the ⅝″ reamed hole to the front edges of the ¼″×15/16″ pieces. These front edges should line up exactly, to bear against the crank-shaft flange. The crosshead slide should have a nice running fit which is easily obtained through the medium of the shim which may be filed down to suit. In boring the countersunk holes for the screws, clamp the three pieces together and drill small holes first. Then redrill to proper size for tapping and clearance.

The wooden parts for the upper structure can also be attended to now. The sliding piece is 1½″ square. The other pieces may be any size to suit your convenience and the location of your machine. The ceiling beams are utilized to hold the overhead support which gives us a large space in which to work, without entailing the use of a large expensive cast arm support. A piece of angle iron will do very well for the tension bracket.

and to have a good running fit, with as little play as possible. No dimensions have been given for the oil cup holes since they will be determined by the size oil cup you buy.

The upper and lower guides are bored and tapped as indicated. A good procedure is to bore with a 15/64″ drill where ¼″ drill rod is indicated and ream out to a nice fit for the drill rod. The rods should fit tightly enough so that they can be moved with the fingers but not loosely enough to permit movement by vibration. The set screws will hold them in place after adjustment. The upper bearing is bored and reamed. We can now assemble our jig saw.

Screw the eccentric pin into the flange and center-punch the rear end to hold it. Slip the shaft through the bushing and force it into the base casting, pushing it in as far as possible. Then slip the lower plunger through the upper hole in the base. Put the yoke on the plunger and over the pin at the same time. Continue the plunger on down into the lower bearing hole. Now, with the top end of the plunger ¼″ below the top end of the base casting, and the crank pin at its topmost position, tighten the set-screw in the yoke, which holds it in position. By revolving the crank shaft by hand, see that you have the proper clearance between the crosshead and the base casting. It should be about ⅜″ above and below. Then with a piece of hard wood, drive the bushing *toward* the crosshead, until there is only sufficient clearance to allow easy running. The less clearance there is at this point, the less twisting



Smaller parts of the jig saw are shown here.

By this time you will have your castings, so the next thing to do is to lay out all holes. Be careful in this. While the saw will work after a fashion even if carelessly constructed, it will not do its best.

Beyond the drilling and tapping of holes there is no other machine work on the large castings. Particular care must be taken with the base, to ensure the two holes for the plunger and crank shaft being at 90 degrees to each other there will be in the saw.

Get this much of the machine working right before you proceed any further. Then tighten the setscrew which holds the bushing in place. Put in your oil cups.

The next step is to attach the lower guide to the under side of the table with 10/32″ F.H. machine screws, making sure that the heads are below the surface of the table. It might be well to check the table with a spirit level. If

necessary, resurface it on a sanding disc faced with emery paper. If badly out of true, it would be best to have it planed off at a machine shop. The table is then attached to the base, and leveled one way by placing a shim or washer between it and the base at the lower 5/16″ stud. It is leveled the other way through the medium of the arc slot provided. The table may be tilted at any time through the same medium.

Attach the upper guide to the oak piece and put the upper bearing and tension bracket in place. Slip the plunger into place and attach the spring to it. The other end of the spring is attached to an eyebolt, which has a washer and thumbnut above for adjustment. Experiment will tell you the correct size spring to use. (The writer found a ½″ brass spring of No. 14 wire, about 5″ long, was about right.) In assembling this upper structure have about 10″ of space between the table and the upper bearing, which allows a saw 8″ long to be used. You will rarely cut stock more than 4″ thick on a jig saw.

After turning the machine by hand until you are sure everything is clearing and running properly, attach a pulley to the eccentric shaft and run it about 200 R.P.M. for a while, until your bearings and the yoke are worn in. Running speed should be about 500 R.P.M.

Who Said—"No More Gold Rushes"

(*Continued from page* 1068)

test them for a half-interest. Few silver bonanzas have compared with the Tonopah diggings that resulted. But the young prospector lost all his wealth in the hard times of 1907. He went back to the desert and garnered another fortune. Today he is Senator Tasker L. Oddie of Nevada.

And only last December a gold rush started to the Rabbit Hole district of northern Nevada, where many square miles were soon staked. Here two prospectors found some very rich ore. Max W. von Bernewitz of the U. S. Bureau of Mines declares that northern Nevada and many other parts of this country are but half explored, especially northeast California, southeast Oregon, south and central Idaho.

Canada he considers "probably the largest and most promising territory for prospecting to be found anywhere in the world. Mexico is intensely attractive. There are enormous areas awaiting the prospector in South and Central America, Cuba, the Philippines and Siberia. Alaska is a territory of great mining possibilities."

At least $350,000,000, authorities estimate, remains locked up in Alaskan placers. Only last year another great strike was made there, termed by an Army Signal Corps operator, who mushed in, "the richest gold strike in history." This is at Poorman, some 57 miles south of Ruby, on the Yukon river. Hundreds rushed in by airplane, dog team and on foot, though it was below zero at the time.

In this Taku region, says the U. S. Geological Survey, "there is a tract ten to fifteen miles wide that warrants careful prospecting, though most of the richest finds made so far lie east of the boundary in Canada."

Scores of Russian geologists are exploring the vast unknown regions of Kamchatka and other areas where gold has been found. John Hays Hammond considers Siberia "probably the most promising of the potential gold fields. For a long time before Russian conditions grew chaotic that region yielded from twenty to thirty million dollars a year. The region around Lena, Siberia, is most promising."

Gold from the depths will in time become the world's mainstay. Below a few miles rock pressures are so great that there are probably no fissures in which minerals could have been deposited. But the earth's interior, even within a mile or two of the surface, opens an *immensely greater field for gold* than all the surface areas so far explored.

Since 1492 the billion ounces of gold discovered (half of it since 1900), would make a cube only 38½ feet on a side, the size of a three-story 18-room house. *One "mother lode" may some day be found that will hold in a single lump as much gold as the world has laboriously gathered in more than four centuries!*

What the Future Holds

Then, too, dredging under lakes, rivers and oceans has only begun. Recently the first successful effort was made to operate a centrifugal pump from a dredge, with a diver at the bottom to handle the hose and direct it into gold-bearing gravel and sand. Like a great vacuum cleaner, it cleaned everything from the rock crevices under water, discharging into a long sluice box, with riffles and mercury to catch the free gold. It proved very efficient.

Thus the gold-famine seems to be far distant, if it ever comes. Infinite are the possibilities of magnetic, electrical, radio and seismographic prospecting from the surface. No spot is too inaccessible for the airplane. Enormous quantities of low-grade ore remain untouched. Increasing quantities come as a by-product in smelting.

Indeed, under the stimulation of demand and bonuses, the present output may be greatly increased. Finally, there is something like ten billion dollars' worth of gold, less an unknown part irrevocably lost, to be reclaimed from jewelry and innumerable other sources, including the millions hoarded in the Orient.

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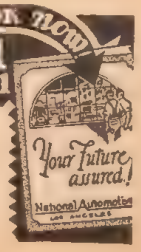

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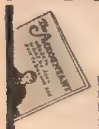

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Sunlight Forms New Molecules

(*Continued from page* 1080)

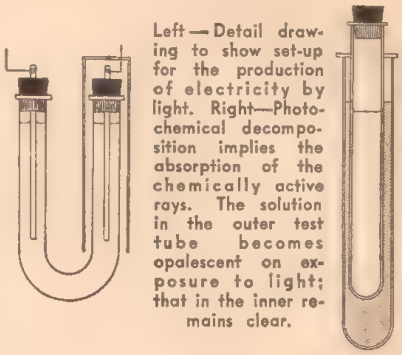
acids. The action is reversible and when chlorine water is exposed to sunlight any hypochlorous acid which had formed loses oxygen.

Insert in a U-tube filled with a dilute solution of sodium chloride two strips of copper foil previously heated in a flame to brown discoloration of the surface. Connect by wire to a galvanometer or any current indicating device. When both limbs of the tube are covered by small cardboard boxes there will be no current generated, but on removing one of the caps a current will be obtained.

The red mineral cinnabar, which chemically is red mercuric sulphide, turns black in sunlight. Realgar, a red sulphide of arsenic, turns into the yellow orpiment when exposed to light. Fine specimens of the mineral in museums are always kept in covered cases to prevent this change.

A water solution of hydrogen peroxide is readily decomposed by sunlight. Copper filings have a catalytic effect on the reaction speeding it up considerably.

Photography with a copper plate can readily be accomplished by the experimenter. Immerse a sheet of bright, clean copper in a dish filled with a concentrated copper chloride solution, made by boiling hydrochloric acid with an excess of cupric oxide until the sheet is uniformly coated with a thin gray film. Remove the sheet, wash and drain for several minutes. While still moist expose under a design, cut in heavy paper, for ten minutes or more to sunlight. After this length of time the design will appear photographed on the plate, the portions exposed to the sunlight being much darker than those covered by the stencil.



Left — Detail drawing to show set-up for the production of electricity by light. Right—Photochemical decomposition implies the absorption of the chemically active rays. The solution in the outer test tube becomes opalescent on exposure to light; that in the inner remains clear.

Lastly we have a very beautiful experiment showing the transformation of an element from one allotropic form to another under the action of light. Dissolve a small quantitiy of selenium in nitric acid. When the reaction has ceased, pass into the solution a stream of sulphur dioxide gas, thus precipitating amorphous selenium as a finely divided, brick-red powder. The sulphur dioxide may be conveniently secured by the action of concentrated hydrochloric acid on solid sodium bisulphite. Filter off and dry this red modification of selenium. On exposure to sunlight it is rapidly converted into the original black modification with which the experiment was first started.

Playing With 2,000,000 Volts

(*Continued from page* 1089)

laboratory and so study the behavior of high tension currents while affected by electrical storms.

The alternating potential is produced by two transformers, each of which is capable of yielding one million volts. One of these is already in use. With the exception of a somewhat similar though smaller apparatus owned by the General Electric Company, this is the only up-to-date single unit transformer which can produce such a high potential. Hitherto several transformers have been connected in series to achieve the same result. This transformer, over 25 feet in height, saves floor space and permits of open construction and simplicity of control. Spherical electrodes used in connection with this work are over six feet in diameter and weigh sixteen hundred pounds each. Again we can say "the largest." The former record-holders are only about 3½ feet in diameter.

The direct current apparatus is in a class by itself. Nothing of its kind has ever been attempted on so lavish a scale. The bank of individual condensers are separated vertically from each other to conserve floor space. Combined, they can build up a potential of two million, two hundred thousand volts. The spherical electrodes are about five feet in diameter. With this apparatus, situations closely similar to those which prevail when lightning discharges into high-tension wires, can be reproduced.

Details have not been neglected. The building housing the machine shop which also contains the generators is separated from the laboratory by an air-space, 33 feet wide, to minimize the transmission of mechanical vibrations. The switchboard is so situated that the controls can be plainly seen from the central position reserved for the experimenters. To forestall accidents, all doors are provided with contacts which cut the current flow, should anyone of them be open.

If preparation is an indication of future success we will soon be hearing great things from the Rosenthal High-Voltage Laboratory in Selb, Bavaria.

Scientific Book Reviews

CONQUEROR OF SPACE, An Authorized Biography of Lee De Forest, by Georgette Carneal. Published by Horace Liveright, New York, N. Y. 296 pages. Price $3.00.

We have always felt that inventors needed a special place of refuge. A haven of peace, safety, and security, somewhat similar to the monastery, should be provided to which they could retire to pursue their investigations. There, unmolested by the cares of a money-mad world, an inventor would be able to devote all his time and energy to the solution of the particular problem which engages his interest.

The life story of every pioneer is a tale of disagreeable contacts with hard-headed, logical, business men who have absolutely no sympathy for what they consider the hare-brained ideas of a demented mechanic. The biography of most successful inventors contains the happy episode in which the technician meets the man of means and vision who is able to furnish him with the wherewithal to continue his researches to a practical conclusion.

As we read Lee DeForest's biography we are very forcibly impressed with the fact that an institution of the nature we have suggested would have been a godsend to him. Time and time again, when he was on the verge of some important discovery, he was forced to discontinue his experiments in order to earn enough money to keep body and soul together. One is led to believe that DeForest was beset not by technical difficulties—time and study would eventually remove them—but that financial worries and monetary hindrances were the stumbling blocks in his rocky path to fame. (But are not all inventors so beset?)

Miss Carneal's attempt to employ a staccato style of expression has resulted in a work which gallops, trots, walks, and crawls in no very definite order. In overemphasizing the struggles which DeForest, the inventor, underwent, the author has omitted much about Lee DeForest, the man.

MAPPING AND LETTERING, by Malcolm Lloyd. Published by P. Blakiston's Sons & Co., Inc., Philadelphia. 58 pages. Price $2.50.

Map-making and associated lettering in order to be readable, understandable, and accurate must be correctly executed. There are no two ways abut it. If the material is not perfectly drawn, the resulting product is often difficult to decipher and in many cases misleading.

Draftsmen, engineers, and designers recognize the necessity for thorough instruction in this field. This manual is an endeavor to assist in the training of both the student and the man actually engaged in the work.

Mr. Lloyd starts from the very beginning and lists the equipment which the student should possess. It is interesting to note the author's advice regarding the purchase of instruments:

"Fine instruments will not make fine draftsmen, but good and suitable tools are a delight and add to your effectiveness. He who does good work with poor instruments does so in spite of them."

EXPERIMENTAL CHEMISTRY, by A. Frederick Collins. Published by D. Appleton & Co., New York, N. Y. Pages XV, 276. Index. Price $2.00.

A. Frederick Collins has started many a youngster and more than one aged adventurer a-jousting in the field of science by showing them how interesting and even exciting a journey a wandering into technical realms can be.

A past master of the art, his present production proves that he has not forgotten how to lead the uninitiated over the boundless sea of bewildering technicalities to the safe haven of understandable first principles, within the compass of plain, everyday language. His book is easy to read, because he always attempts to detail the simplest methods of demonstrating various principles without being in any way patronizing or condescending.

A series of experiments explained, step by step, enable you to find out for yourself what happens when certain substances combine. For those not inclined to duplicate these performances the accompanying expositions of the whys and the wherefores of the reactions obtained will serve very well.

AVIATION ENGINE EXAMINER, by Major Victor Wm. Page. Published by Norman W. Henley Publishing Co., New York, N. Y. 448 pages. Index. Price $3.00.

All over the country youthful enthusiasts are learning to fly. Some of them are undergoing intensive training in preparation for a pilot's career. Others are merely studying flying for the same reason that so many hundreds of thousands learned to master the motor car—search for a recreational outlet.

"Aviation Engine Examiner" will interest both groups. Through its question and answer presentation the book provides an excellent taking-off point for the inquiring student. The man who is anxious to familiarize himself with the different types of airplane power plants, their construction, installation, uses, advantages, operating characteristics, maintenance and repair will find this work a source of information which will stimulate search for further knowledge along the same lines.

The plane owner who is his own pilot and occasionally finds it necessary to service his craft will find the data Major Page has provided most instructive. The more understanding care which he will be able to give his motor will ensure a longer and more satisfactory life.

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Weighing the Earth

(*Continued from page* 1073)

"The first thing to do is to set up a miniature system representing the earth and a body near its surface, and to determine by experiment the actual force of attraction between these bodies. This force depends on several factors. The force of gravitation between any two bodies varies inversely with the square of the distance between them; it also depends on the masses of the bodies, greater bodies attracting one another with more force than smaller ones.

"In the actual case of the earth and a body on its surface, we can measure all but one of the quantities involved. We can weigh the small body and thus determine the force with which the earth attracts it. We can determine by the same operation the mass of the small body, and we know the distance from its center to the center of the earth.

"What we do not know is the mass of the earth. But by applying the results of our miniature experiment, in which every quantity was known, and solving the problem in proportion, we can calculate it.

"The most difficult part of this experiment is to determine the force of attraction between the miniature earth and the small body attracted by it. Even with a mass of steel weighing 140 pounds (which was used in the Bureau of Standards experiment) and a ball of gold weighing an ounce and a half, the force is measurable only in millionths of a grain, in metric units about a thousandth of a milligram.

The Torsion Pendulum

"To determine this very small force with the necessary precision, an arrangement called a torsion pendulum is used. (See sketch.) A light rod of aluminum about eight inches long is hung by a very fine filament of tungsten at its center. This filament is such as is used in incandescent lamps. The rod hangs in a horizontal position and carries at each end a gold ball. The rod swings very slowly back and forth in a small arc, with a time of swing of about half an hour. So delicate is this arrangement that a very small force applied to the balls will perceptibly alter its time of swing.

"Between the two balls, a wire is attached to the end of the tungsten suspending wire and its lower end. It carries a perfectly flat mirror which has been ground to give a true plane surface. The oscillation of the pendulum is recorded by a scale, the reflection is caught in this mirror, and readings taken through a telescope. The observer was stationed ten feet from the apparatus so that his movements would not affect the action of the pendulum . . . as a matter of fact, his movements were restricted—he was permitted only to sit down or stand up, not to move horizontally.

"The swinging system is enclosed in an airtight case from which the air is exhausted," continued Dr. Heyl. "This eliminates trouble from air currents which might disturb the swing, and also allows the system to swing for a long time before coming to rest.

"Outside this case the two large steel masses are placed, at first as close as possible to the gold balls inside." Our illustration shows the general arrangement of apparatus. In this position, the time of swing of the torsion pendulum is measured. The steel cylinders are now moved as far away as possible from the balls and the time of swing again measured. Due to the diminished attraction of the steel masses for the gold balls at a greater distance, the time of swing is now found to be about five minutes greater. From observations such as these the actual force of attraction between the steel cylinders and the gold balls can be calculated."

Starting the Swing

A further detailed non-technical explanation may be here inserted.

We have all seen something of the same sort in torsion pendulum clocks, which go for a year with one winding.

When the metal portion of the container was in position and all joints were packed, the air was exhausted and the suspended element, the two balls at the end of the cross-bar, started swinging. To do this flasks or bottles of mercury were placed to one side and the force of gravity between them and the suspended balls moved them a little to one side. Then when they had reached the limit the mercury flasks were quickly put in the reverse position, so as to pull the balls back and a little further, and in this way the element was set into oscillation in a horizontal plane. Working with the two bottles of mercury as described, it took two hours to get an amplitude of oscillation of four degrees, that is 1/90 of a circle, and then the oscillation would continue for 20 hours. The two large elements seen on each side of the suspended torsional element were of steel, each forged down from a large ingot so as to close up any holes or pores in the metal. The particular grade of steel selected was one which gave a very uniform ingot even without treatment. Each mass weighed a little over 66.3 kilograms, about 146 pounds.

We now have a torsional pendulum whose natural period is checked by the presence of any matter, and the two large cylinders operate to check the swing. The object of the experiment then is to measure the action of the masses of the two cylinders upon the suspended balls. The cylinders reduce the oscillation of the balls, and this reduction is measured and from that the value of the constant of gravity, "G," is obtained by the most elaborate mathematical calculations. A thousand sheets of paper were used in the calculation of the factor "G."

The metallic balls of gold had been fused in a furnace in which a vacuum was maintained so that they would be

entirely free of bubbles in the interior. The platinum balls were fused in the oxyhydrogen flame. The balls were brought by hammering almost to the final size and then were laid upon a plate of steel in which an absolutely accurate hole had been cut and by working the ball around the edge of the hole an absolutely perfect sphere was produced in each case. It is practically impossible with a micrometer to detect an error in the shape or size of the balls.

One rather interesting detail was a train of wheel work in the top by which the torsion wire could be twisted one way or the other. This is contained in the vacuum; a bar magnet attached to this train of wheel work made it possible to move it by magnetic action so as not to interfere with the vacuum.

It is by the application of the constant of gravitation that the mass of the earth and other celestial bodies is determined.

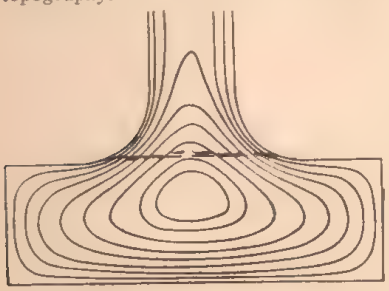
When Scientists Blow Soap Bubbles

(*Continued from page* 1072)

air-capacity of this transparent pincushion is a direct measure of the twist resistance of the solid beam you started with.

Aluminum plates are used for experimenting, instead of building and breaking expensive model beams by the truckload. These have holes cut in them—holes the same shape and size as the cross sections of the various kinds of wing beams. Bubble films are spread over these holes, the bubbles inflated slightly and then measured for the volume of each bubble. By comparison of bubble volumes the twist resistance of each shape of wing beam was determined, accurate to four per cent.

These bubbles must be blown up by a current of pure air. Ordinary human breath would destroy the film within too short a period of time. The next step is to measure the slopes and contours of the bubble. This is a delicate and tedious process similar to the work which is done by a land surveyor in gathering field data and mapping topography.



Lines show formation of soap bubble humps, indicating that the greatest strength of the T member is near the junction of the two rectangles.

In carrying out the experimental work, a film was drawn across the holes with a strip of celluloid wet with soap solution. The blowing up was done through a burette, the bottom of which was connected to the lower end of a column of water, through a stopcock, and the top to the chamber below the test plate. As water was passed into the bottom of the burette, air was forced out of the top into the apparatus.

The soap solution was made by adding a very small quantity of triethylamine oleate to a fifty per cent solution of glycerine in distilled water. The triethylamine oleate was prepared as follows, using two grams of triethylamine to five grams of oleic acid. The amine was dissolved in warm water and the oleic acid was slowly stirred in. Excess amine in the emulsion was expelled by distillation and the water was expelled by subsequent evaporation on a steam bath. Other oleates, such as ammonium, sodium, and potassium were found to be quite successful, but the triethylamine solutions proved to be the most resistant to atmospheric impurities.

When the soap bubble slopes and contours have been measured, the investigator has data from which he can compute the stresses that will be produced in the airplane part by the loads and twisting it will suffer in surface. The soap film is not loaded or twisted—it happens that there is an absolute analogy between the contours of the bubble and the stresses in the airplane part whose cross section it represents.

To the mathematically minded, Mr. Trayer's efforts and those of Professor H. W. March of the University of Wissonsin, who collaborated with him, are of particular interest in revealing how even a soap bubble's shape is important in the perfection of the perfect airplane.

Mr. Trayer states that "if a soap film is stretched over a hole in a flat plate, the hole being the same shape as the cross section of the bar and the film being displaced from the plane of the plate by a slight difference in pressure on the two sides the following relations hold:

"1. The shear stress at any point of the cross section is proportional to the slope of the film at the corresponding point with respect to the plane of its boundary.

"2. The contour lines of the film represent the direction of the resultant shear stress at every point.

"3. The torsional rigidity of the section is proportional to the volume between the soap film and the plane of the plate."

In use the stresses in the bar are proportional to the inclination of the film and the stiffness of the bar is proportional to the volume generated by the film displacement. "The relations hold for any number of films provided the difference in pressure on the sides of a film is the same for all." Mr. Trayer explained. "This condition is readily attainable by making more than one hole in the same test plate; it is evident that the easiest way of obtaining actual

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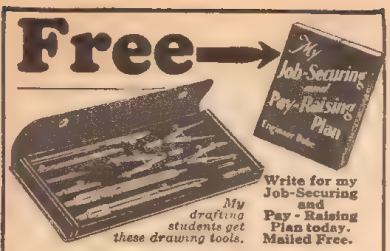

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stress or rigidity values is to have a circular hole in each plate in addition to the hole that represents the section being studied. The rigidity of a circular shaft and its stresses are easily calculated, and having the two films in the same plate makes it possible to compare torsional rigidities directly by comparing volumes, and to compare stresses directly by comparing slopes."

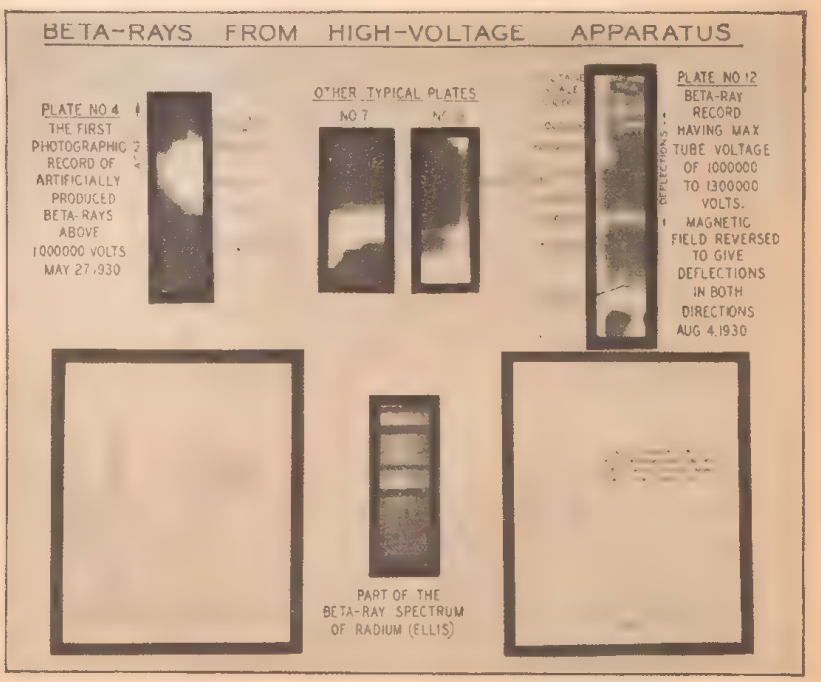
The engineers of the National Advisory Committee for Aeronautics say that the results of such experiments and the findings, while checked largely by tests of wooden specimens, apply equally to wood and to metal, due consideration being given to the elastic properties of the materials used.

Penetrating the Atom with Beta and Gamma Rays

(*Continued from page* 1091)

tion which is now in progress leading to the introduction of protective measures which will insure against injury to the investigators from the radiations.

Considerable interest has been aroused in the possible application of the gamma-rays from high-voltage tubes to the treatment of cancer. It must be remembered that the apparatus in the department's laboratory was designed for studies in atomic physics and not for possible medical applications. Although the equipment now in use at this laboratory gives very high voltages, it is of small power. It produces gamma-radiations equivalent in quantity to those produced by very large amounts of radium, but only for extremely short periods of time, the tube being operated intermittently. To increase the total intensity of the radiation would require increasing the fraction of time in each second during which the high voltage is applied to the tube, thus increasing the time-average of the intensity. Limitations in the size of the electrical equipment, the lack of need for large intensities of radiation for the first physical measurements, and the desire to minimize the personal risk to the investigators themselves from heavy exposures to the rays, have been factors opposing any increase in the total intensity of the radiations so far produced at this laboratory. If large intensities of gamma-rays, comparable to very large amounts of radiation, are desirable for medical purposes, it is, so far as can be foreseen, chiefly, a matter of providing the necessary equipment.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OTHER TYPICAL PLATES
NO 7
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MAGNETIC FIELD REVERSED TO GIVE DEFLECTIONS IN BOTH DIRECTIONS AUG 4 1930
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Fig. 5—Typical photograph records produced by beta-rays, and curves showing the distribution of beta-rays from radium and from high-voltage sources.

TOOL CONTEST ANNOUNCEMENT

The prize winners in the Ideal Home Workshop Contest will be announced in the May issue of this publication. In addition, the complete plan of the first prize-winning entry in each of the three groups will be published. The other prize-winning entries will follow.

Strongman Tricks Which You Can Do

(*Continued from page* 1083)

end. Return the bar to the audience and challenge anyone to straighten it out. It is almost impossible for even an exceptional man to do so, as the shape of the bar is such that it will not permit the same leverage which you were able to obtain in bending it.

There are numerous folk traveling about this wonderful country of ours, who daily tell eager and appreciative audiences that they are able to tear phone books because of the unusual muscular devolopment of their hands.

The strength of four men pitted against that of a girl can not separate her arms!

Hand bills distributed by zealous press agents carry announcements of the arrival of "The Man With the Iron Grip," who rips phone books in half. Half of each statement is absolutely true—these men perform the stunt which they advertise. However, any person who is gifted with no more than ordinary strength can do this stunt, just as effectively after he has received proper explanation. Limited space permits the listing of only three ways.

The first method is the simplest, easiest, quickest, and therefore most dramatic and effective. Hold the book at the back (where it is bound) in both hands. The heels of your hands should rest on the cover which faces you. The fingers should be extended so that they curl around and lie on the cover of the book opposite to that on which the back of your hands rest. The thumbs are parallel to the fingers. Now break the binding by placing the book on your thigh and pressing down with an equal pressure on both hands. Finish by raising the book to your chest, pushing with one hand and pulling with the other.

If you think this way is too easy, try this one. Hold the book so that the front and back covers are parallel to your chest. The hands assume the same position as they did in the first method, except that instead of holding the bound edge, you are holding the paper edge. The thumbs are extended away from the fingers and point toward each other. Hold the book loosely and bring both sides in so that a bow forms in the center. When the two sides are as close together as possible, tighten your grip and straighten the book out again. As you do so, the pages will tear one by one. However, as this is a continuous process, the fact that a single page is being torn at a time, is not noticeable. Finish off as previously explained.

For our last method, you will have to hold the book just as you did in the second. Now fan the leaves toward you. Push away with one hand and pull with the other. This is the most difficult feat of the three, as it requires a fairly strong grip.

Now that you know how to tear phone books, you may as well as add "ripping a deck of cards" to your repertoire. Hand a deck of cards to one of your friends who prides himself on his strength and ask him to tear them in half. It is surprising how clumsy a big man appears when he attempts to grip relatively small, slippery objects. He will do everything but tie himself into a knot before he will confess himself beaten.

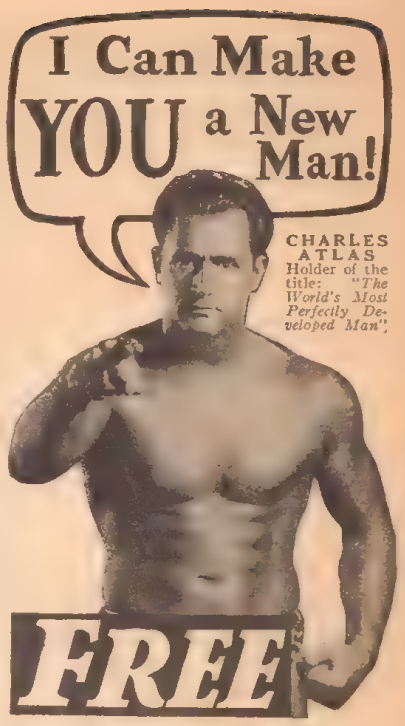
When you show how it can be done, hold the cards vertically so that one end of the deck rests in the palm of your left hand. Your fingers point to the top of the deck. The thumb is bent and rests on the first finger. The palm of the right hand is placed against the side of the deck furthest from your body. The fingers are bent and touch the side of the deck nearest you. The thumb extends over the top of the deck and rests on the first finger. Bring your two hands as closely together as possible, tighten your grip and at the same time turn your left hand in a clockwise direction and your right hand in an anti-clockwise direction. Please throw the pieces into the scrap basket.

Another very popular and exceedingly impressive demonstration is that in which a well-built individual breaks a heavy chain by wrapping it around his chest and then inhaling. To prove that the chain has not been doctored, he will allow any number of men to use it in a tug-of-war. According to his statements, the expansive force of his mighty latissmus muscles split the links.

With the proper preparation you can do just as well. Take an ordinary chain, one that has welded links and will resist a strain of several thousand pounds. File the last link at one end until it is cut almost all the way through. Fill this nick with soft solder. When you are about to perform this stunt, you can safely hand your chain over to your audience. Urge a number of men to test the chain by pulling on it. Naturally, their hands either cover or are in front of the treated link. Therefore, your ruse will not be detected.

When the chain is returned to you, exhale and contract your chest. Wrap the chain tightly about you and secure the prepared link with an "S" hook to as much of the chain as you find necessary to make a tight fit. Breathe in deeply and lift your chest. The defective link will snap and fly off to some corner. As the chain falls to your feet, take a deep bow and thank your audience for their applause.

Just as an aside, a description of an act that won fame and fortune for its originator is included. You yourself will not be able to duplicate this stunt



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The real test of strength is not in doing such tricks as tearing a phone book, bending a steel rail, or letting a car or wagon run over one's chest. The kind of strength I give a fellow means Endurance, Stamina, Power—the ability to dip to the floor or bend backward or forward six or seven hundred times without tiring—the ability to plunge into the play or work of life and enjoy it to the full, feeling like A NEW MAN—without continuous worry about weakness, sickness, and lack of energy.

THAT'S *true* strength—the kind that counts, the kind that everyone wants. And it's the kind I can give to YOU!

I've helped more than 20,000 other men, youngsters and oldsters, fat and skinny. Some were weak, run-down specimens that looked like scarecrows before I showed them my NO-APPARATUS way to add weight, get smooth, even layers of powerful muscle and the handsome, evenly balanced proportions that you see in my own photo.

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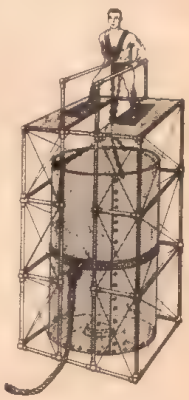
because of the extensive paraphernalia involved. However, it may give you some ideas which will enable you to work up a breath-taking, applause-getting stunt of your own.

As the curtain rises, a large metal tank is seen. The strong man appears and explains that the huge cylinder and the water which fills it weigh over 2,000 pounds. He then requests twelve men from the audience to come upon the stage and attempt to move this tank by pulling on a rope attached to it. Despite their combined efforts, they are unable to even budge the tank. And they are finally forced to admit that as far as they are concerned it is immovable. The strong man flexes his muscles, strikes several graceful poses and takes a position on a bridge placed over the tank. He bends his knees to slip on the ropes to which the tank is attached. Slowly, swaying from side to side, because of his efforts, he straightens out, lifting the massive tank from the floor as he does so. His audience stares in wonderment, and can in no way imagine how he is able to perform this prodigious feat of strength. What they don't know is that while



The empty tank is easily lifted.

the vaudeville performer was engaged in "stage business," the tank was emptied through a valve in the bottom and all connections between it and the stage floor were then removed through a trapdoor.

Practically every strong man shows his audience that he can drive a nail through wood with his fist. You can rest assured that there is nothing phoney about this stunt. It is often done before a wary and suspicious crowd. The plank must be solid and untreated because the spectators are allowed to examine it before it is used. Yet, no extraordinary amount of strength is needed to duplicate this feat. Skill and knowledge alone are essential. A combination of soft, straight-grain wood and a sharp nail makes the accomplishment of this amazing stunt easy. You had best start with wood about one inch thick. A word of caution,—take it easy until you have an idea of how much force is required; otherwise you may bruise your knuckles. Support your plank solidly on two foundations which are separated by a six-inch space. You can substitute a door panel for the plank. Wrap a handkerchief carefully and firmly around the head of a twenty-penny nail. Hold the nail in your fist, with the head resting in the back of your palm. The shank of the nail, protruding between the third and fourth fingers, your wrist, and forearm should be in a straight line. In this way, you are able to strike straight from the shoulder and use the full weight of your

body. You can also hold the nail head against the palm of your hand. This position permits you to take advantage of the long sweep of the arm, but you cannot put the weight of your body in back of the nail when driving it home.

An old standby of vaudeville strong men which causes their audience to gape with astonishment is that in which the strong man calmly lays himself upon a bed of nails and permits an assistant to pound with a heavy hammer upon a massive anvil which is lowered by a block and fall upon his chest. The cash customers cannot understand how the strong man is able to lie with perfect ease and equanimity on his sharp-toothed support. Especially, since he is obviously being crushed by the anvil, which probably weighs almost as much as he himself does. Furthermore, his ability to sustain the heavy hammer blows, situated as he is, seems to indicate that his body is built of high grade steel springs.

Astonishing as it must surely seem, there is nothing remarkable about this demonstration, except the amazement of the unitiated. If you want to prepare your own equipment, get a plank and stud it with nails—but blunt them. The nails must be placed very close together and it is essential that they all be of the same height. When you lie upon this unusual couch, you are supported at so many points that the weight upon any individual nail is negligible. As a result, you feel almost as comfortable as if you were reclining on a bed of newly cut grass. When your assistants place the anvil upon you, although it appears to be an impressive feat of strength, you will find it easy to support the load on the long bones. The hammer blows are absorbed by the bulk of the anvil itself. If you wish, a big rock can be substituted for the anvil. We suggest that you exercise caution in attempting this stunt. The bed of nails must be carefully built. But use a large stone to absorb the hammer blows and at first have your attendant tap lightly until you find out just how much you can stand.

Paul von Boeckmann in the chain-breaking pose.

Paul von Boeckmann, former amateur wrestler of America, and one of the leading physical culturists of America for more than thirty-five years, in commenting upon strong man stage tricks, states:

"Tricks are used in feats of strength on the stage, mainly because the public are unable to fully appreciate the merits of real feats of strength. Hence, a performer does the spectacular, rather than the really difficult feats.

"I knew the great Sandow, the greatest of them all, very intimately. One night, after one of his performances, which I witnessed, I asked him which of the various feats he did required the least effort, and which the greatest efforts. As could be expected, the feat that brought the most applause from the audience, known as the 'Roman Column,' was the easiest to perform. On the other hand, the feat of stretching a bundle of rubber bands—'Arm Stretch,' which he performed, compelled him to exert the limit of his strength, and it was the least appreciated by the audience.

"No," he said, in commenting upon chain breaking, "no man can break a genuine chain with welded links, such as shown in the accompanying photograph."

"Open link chains, especially 'doctored' chains, can easily be broken over the chest, biceps, and in the manner illustrated.

"Yet, with all that," he says, "the strength of a strong man is tremendous, as compared to the strength of an ordinary man, trickery or no trickery."

Radio Equipped Toy Balloons to Aid Aviators

(*Continued from page* 1085)

communication with his partner who is seated at a plotting board. The latter takes down the observations telephoned to him from outdoors, and a picture of the flight of the balloon is made. From this picture or graph the velocity and direction of the wind at various altitudes is found and the information is broadcast to aviation fields for the use of airmen.

When fog overhangs the earth, or at night, when observations by visual methods are impossible, a radio method is used. This has been perfected by the Signal Corps engineers at Fort Monmouth and has been proved accurate. A continuous wave transmitter is sent aloft with the balloons, three of which are used, and by means of a direction finder, such as is used in radio compass work, the flight of the transmitter is followed and plotted, the same method being used as for the visual recording.

The efforts of the Army are not designed to overlap those of the Weather Bureau, but are for the purpose of obtaining specialized knowledge that will be of particular aid to Army airmen.

END NERVE TORTURE— or it will END YOU

If you are nervous, mentally and physically depressed, cannot sleep, have nervous indigestion and similar symptoms, you are *at least* in the first stage of Neurasthenia (nerve exhaustion).

Paul von Boeckmann
Nerve Culturist—Psychologist

Nerve Exhaustion manifests itself in many ways from simple restlessness and minor organic troubles to mental tortures that make life a living Hell. Thousands every year commit suicide because of their nerves, and many more go insane. The symptoms of Nerve Exhaustion vary according to individual characteristics, but usually they develop as follow:

First Stage: Nervousness, restlessness, sleeplessness, lack of energy, poor circulation, and other minor symptoms of low vitality.

Second Stage: Nervous indigestion, belching, sour stomach, gas in bowels, shallow breathing, decline in power of the reproductive functions, high or low blood-pressure, hot or cold flashes, heart palpitation, mental uneasiness, irritability, undue worry, despondency, lack of self-confidence, etc.

Third Stage: As nerve weakness advances, the symptoms mentioned before become more severe. It is then the more severe mental symptoms appear; namely, fears, melancholia, dizziness, loss of memory, hallucinations, suicidal thoughts, and finally INSANITY.

How About YOU?

If only a few of the symptoms mentioned here apply to you, especially those indicating mental uneasiness, you may be certain that your nerves are weak and deranged. Fight this weakness as you would fight for your life. **Conquer it, or it will conquer you.**

Strengthen Your Nerves

I can help **YOU** as I have helped over 150,000 others during the last 30 years. Nerve exhaustion is a *condition* of the nerves and not a disease. The Nervous System can be built up and made immune to ordinary strains of life by simple methods you can apply at home. *Write for further information.*

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I offer to send you **FREE** my 64-page book entitled *"Strengthening the Nerves."* This book contains much valuable information on the care of the nerves—how to prevent Nerve Exhaustion and explains in simple language **WHY** we are nervous. In accepting this offer, you obligate yourself in no way to buy anything. Send 10c to cover postage and mailing. This book is not an advertisement, which is proved by the fact that it is on file in many public libraries and at the National Library at Wash., D. C. *This offer is bona fide in every respect.*

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The April Issue of
RADIO NEWS

contains many interesting articles by prominent writers. Included in the April contents are:

An article by Albert Pfaltz on KDKA's new 400,000-watt transmitter.

The subject of photocells and their applications is discussed by two engineers of the Westinghouse Electric and Manufacturing Company, H. B. Stevens and M. J. Brown.

Lieut. Wenstrom describes a new system for making national broadcast coverage direct.

The elaborate radio communication system of the Pan-American Airways is ably described by Zeh Bouck.

Mr. McClatchie contributes a second article on the subject of "pick-ups."

Don Bennett writes the fourth of his series on the Junior Transmitter describing the dynatron frequency meter.

In addition there are the usual departments, including Mr. Bouck's Service Bench, In the Radio News Lab, Home Laboratory Experiments, Junior Radio Guild, etc.

Flying Taught by Mechanical Instructor

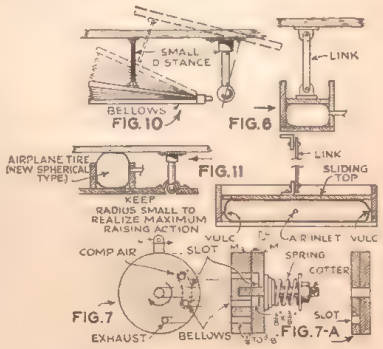
(*Continued from page* 1101)

canted over to one side.

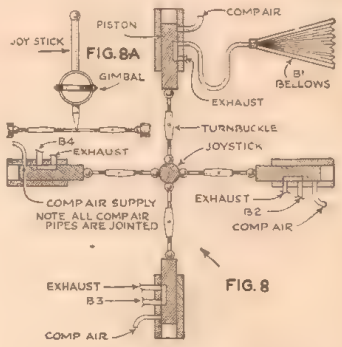
Thus, when the current is switched on the student has to start in at once moving the joystick, in order to bring his craft up to a level keel, or as near as he can manage it. To throw the "wise guy" off his track, it is a good trick to secure a spiral spring to one side of the rudder foot-control bar. In this way the rudder bar will always be off its neutral position, and the student will also have to exercise a little pressure on it from the start, in order to keep his craft from turning.

By this time our prospective builder of the mechanical pilot trainer will perceive that there are six movements which the student has to conjure with. He will have a lot of fun and pleasure trying to keep the craft on a level keel and from turning. He will find, for example, that when he moves the joystick to bring up a low wing, his brain will usually "skip a cog" and before he knows it, his miniature plane will be slowly turning to the left or right.

A simple way in which to make this trainer rotate is by means of an old gear wheel mounted underneath the secondary platform, as shown at P1 and P2 in Fig. 4. Another detail of the rotating mechanism, which makes use of a round leather belt running in two grooved pulleys, is shown in Fig. 9. A chain drive, as one obtained from an old bicycle, may be brought into service for this purpose, mounting the small sprocket on the end of the motor shaft, and the large sprocket on the center spindle supporting the whole trainer.



Assuming that an electric motor is to be used for the purpose of rotating the plane, the electric circuits for both series and shunt wound motors, with simple reversing switches, are illustrated in Fig. 9. It becomes evident that, if the student pilot pushes on the rudder-control bar a little too much to the right or left, he will move the pivoted switch to one side or the other, and close the circuit through the motor which rotates the trainer. With a little ingenuity any desired variation of this means of rotation may be worked out. You may desire to mount the parts of the switch on adjustable insulated blocks, so that this control switch could be set for different limits of variation; that is, you may set the switch so that when the pilot moves the rudder bar two degrees either way, he closes the motor circuit, and is promptly tormented by the fact that his plane is slowly turning, probably while he is struggling gloriously to bring up a "low right wing."



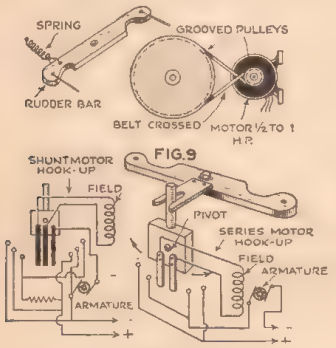
The average student who builds one of these trainers and gets into the cockpit for the first time, may decide that the control devices are a little too snappy for him; in this case there are a number of things he may do to smooth up the action of the "monster." Various damping means may be utilized, such as springs or friction arrangements, which will cause the oscillating platform to move more slowly. Another important factor is the design and size of the pneumatic members used to raise the platform on one side or the other, and also the air pressure supply to the pneumatic devices, such as bellows, air cylinders with pistons in them, or "what have you?"

You may wish to have your ailerons, rudder and elevators operate just like those of a regular plane, whenever you move the joystick. If such is the case, the cable control diagram given at Fig. 3 will furnish the directions you desire. The usual source of the compressed air is shown in Fig. 5, and it is, in brief, equivalent to a small automatic air-tank and pump outfit, such as is found in the average public garage. You may duplicate the compressed air outfit by purloining an old kitchen boiler of thirty to fifty gallons capacity. A small air compressor and an electric motor can be picked up either new or second-hand from garages or machine shops at a nominal cost. It hardly pays to make an air compressor unless you are quite ingenious and wish to use an old engine and re-fit it with suitable valves.

The air pressure used may vary from 40 to 80 pounds, depending upon the kind and size of pneumatic expansion devices you employ. It is imperative that you have an automatic electric air pressure switch, fitted on the compressed air tank, so that when the pressure reaches about 60 to 70 pounds, the compressor motor circuit will be opened.

Referring for a moment to the design of the air valves which are connected to the joystick in Fig. 8, you may desire to work out your own ideas along these lines. The valves as shown in

Fig. 8 comprise piston type valves, sliding inside of tubes, and any machine shop can make them for you, if you have no facilities for making them in your home workshop. A flat portion is filed away on one side of each valve piston. A little study of Fig. 8 shows that normally each one of the pneumatic expansion bellows is connected to the exhaust openings on the valves. If you should move the joystick to the right, (consult Fig. 8), the left-hand valve piston would be moved to the left, admitting the compressed air through the filed-away portion of the piston to the bellows B1, causing it to expand and push that side of the plane upward.



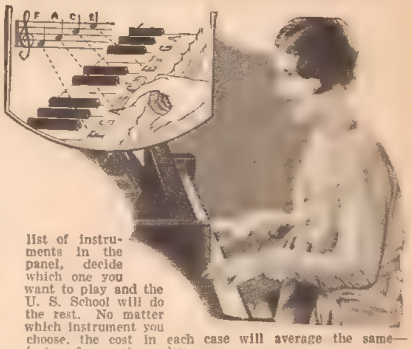
Another idea for compressed air control valve is illustrated in Fig. 7. You may like this one a little better than the one described in Fig. 8. The air control valve shown at Fig. 7 comprises one stationary member M, and one movable member M1. The moving valve is caused to rotate through part of a revolution by means of the lever shown projecting from the top. There are three openings in the stationary member M, one for the compressed air outlet, the second for the bellows supply, and the other for the exhaust. There is a slot or cavity drilled out of the metal, as the drawings show, and if you have difficulty in forming this slot in a solid piece of metal for M1, you may find it simpler to make it from two pieces of metal, drilling and filing the slot in one piece of metal and then sweating a second "blind" piece up against it as shown at Fig. 7A. A fairly stiff spring is placed between two washers, held in place by a couple of lock-nuts or a cotter pin.

The "error" counter, in one of its simplest forms, is illustrated diagrammatically by Fig. 2. The principle of this error indicating dial, which counts up how many mistakes you make in a given time, is based on the fact that whenever the platform of the trainer tips downward at a certain angle, electrical contacts are closed and an electric bell or other electric mechanical device, like that shown in Fig. 2, is caused to pull the ratchet around one tooth, this ratchet being secured to the same shaft which carries the needle on the front of the "error" counter.

Thus, each time you tip downward either fore or aft or perhaps sidewise beyond a certain angle, the dial indicator will check up another error against you! A world of fun and sport among our junior aviators and their friends can be had.

Just as EASY as it looks

to become a popular musician this simple as A-B-C way



STOP cheating yourself out of musical good times. Stop thinking that learning music is nothing but one grinding session of monotonous exercises after another . . . days, months and years of difficult technique under the thumb of a private teacher.

Take a look at the above diagram. Looks easy, doesn't it? Well, it's every bit as simple as it looks. First a note, then a letter. Plenty of clear instructions tell you how each bar is played—lots of diagram pictures show you how, then you do it yourself and hear it. Everything to make learning a joy. In fact, the U. S. School of Music has made the reading and playing of music so simple that you don't have to know one note from another to begin.

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How can you be content to sit around at party after party and listen to others do all the playing—see them showered with admiration, invitations—when your life-long ambition to become a popular musician is now so easy to realize? Experience the personal satisfaction that comes from being able to play "when," "where," and "what" you like for your own amusement and the entertainment of others. Don't be afraid to begin your lessons at once. Over 600,000 people learned to play this modern way—and found it as easy as A-B-C. Read the list of instruments in the panel, decide which one you want to play and the U. S. School will do the rest. No matter which instrument you choose, the cost in each case will average the same—just a few cents a day.

LEARN TO PLAY BY NOTE

Mandolin	Saxophone
Piano	'Cello
Organ	Ukulele
Violin	Cornet
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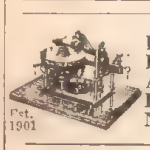

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LADIES FROM MISSOURI

FOUND in the back of any old cook-book, in the "Useful Compendium of Household Hints."

"To test muslin for 'filling'—rub a small section vigorously between the forefingers, and note any starchy substance that breaks out of the fibers.

"To test for color-fastness—before buying wash goods of any kind it is safest to obtain small samples of all patterns and soak in clear water.

"To detect cotton in an 'all-wool' fabric—pull the threads apart and apply a lighted match," etc., etc.

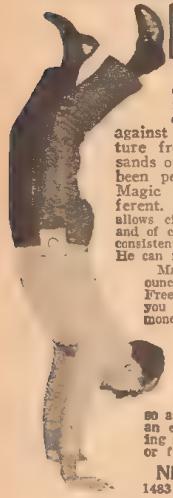
How funny they were—these old suspicious-of-everything shopping tests! Grandmother knew them all by heart, and descended on Mr. Biggs, the linen draper, with defiance in her eye. Her little, moistened forefinger shot suspiciously under every proffered length of sheeting or dish-toweling. She took nobody's word for *anything!*

But how differently you approach a yard-goods purchase in any store today. A name on the selvage . . . a label on the end of the bolt . . . a guarantee-tag that also suggests a method of washing. These are your safety-signals in buying. To the questions "Will it wash?", "Is this pure wool?" or "pure silk?", the saleswoman has only to remind you of the trade name of the fabric. When she mentions a name familiar to you through advertising, your doubts are dispelled.

Yes . . . we still look before we leap, but today that means READ BEFORE YOU SHOP!

Button Rupture Newest Way

Without Cruel Pressure



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Magic Dot weighs less than an ounce. It comes to you on a generous Free Trial, by Actual Wear, and if you are not pleased, you have your money back. With it comes all needed accessories to allow you to abandon your present truss if you so decide. Users often forget they are wearing Magic Dot.

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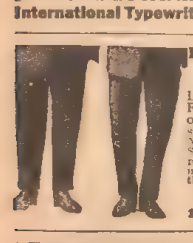

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Answers and Prize Awards in January Puzzle Contest

First Prize, of $10, is awarded to:
Czar J. Dyer, 619 E. University Ave., Ann Arbor, Mich.

Second Prize, of $5, is awarded to:
L. S. Shively, 407 Riverside Ave., Muncie, Ind.

The ten prizes, of one dollar each, are awarded to the following:

Walter R. Noe, 2294 Washington Ave., New York City.

Le Roy L. Holden, 3 Bayberry Road, Worcester, Mass.

William Thomson, 1224 Park Ave., Alameda, Cal.

J. E. Stoddart, 3103 Dupont So., Minneapolis, Minn.

Herman Howe, Box T, Leavenworth, Washington.

A. Fallenberg, 350-62 Street, Brooklyn, N. Y.

J. O. Uhink, Box 275 R.F.D. 1, El Paso, Texas.

Edward C. Milde, 34 Boynton Street, Worcester, Mass.

H. Alton Davis, 334 High St., Oshkosh, Wis.

J. B. Amster, 106 West 47th St., New York City.

Solution to "Dealing in Expectations"

In the pairing of their shares under the terms of Uncle John Robbins' will, it was told that Aaron and Barbara were together to receive $14,000, while Barbara and Celia would have got $20,000. This proves that Celia's portion exceeded Aaron's by $6,000.

Also, we were informed that Celia's share plus that of Dora amounted to $18,000, while the combined shares of Dora and Edward totaled $12,000. This proves that Celia's portion exceeded that of Edward by $6,000.

Thus it is established through comparison with Celia's share that the portions of Aaron and Edward were alike.

Adding together the given paired portions of the heirs, we have a total of $64,000, and of this total the shares of Barbara, Celia and Dora are each represented twice, and those of Aaron and Edward but once.

Aaron and Edward together must have inherited two-fifths of the total bequests, since it was told that their combined shares gave them each the average portion of the entire five. Therefore, $64,000 equaled eight-fifths of the total bequests, which total must have been $40,000.

Having proved that Aaron and Edward each inherited $8,000, and applying these known quantities to the pairings, it is revealed that John Robbins' bequests were as follows: To Aaron, $8,000, to Barbara, $6,000, to Celia, $14,000, to Dora, $4,000 and to Edward $8,000.

Solution to "Rolling the Bones"

Since one die can be thrown in 6 ways, the three dice could be thrown in 6x6x6, or 216 ways.

Of the 216 ways, the throw of 7 would occur 15 times, and the throw of 11, 27 times.

Therefore, the probability of throwing 7 or 11 in a single throw of three dice is 42 chances out of 216, or as 7 is to 29.

Bookcases in the Modern Mode

(*Continued from page* 1107)

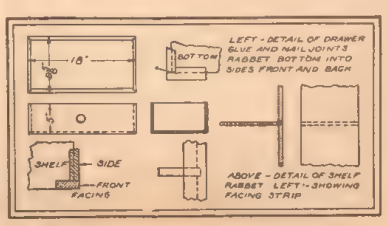
constructional work. Here are separate lists of stock necessary for each article.

BOOKCASE AND SECRETARY

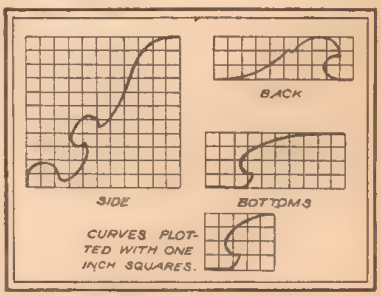
⅜" Plywood
2 12" × 64" sides
1 18" × 65" back
8 8" × 17¼" shelves
2 12" × 17¼" shelves
1 7" × 18" top facing
1 4¾" × 18" bottom facing
1 1" × 18" under desk shelf
1 2⅝" × 16" compartment door
1 1" × 10'-0" facing strips
2 5" × 16" drawer F. & B.

¼" Plywood
2 5" × 7¾" drawer sides
1 7¾" × 17" drawer bottom

Miscellaneous
1 ¾" × 14" × 21¼" desk shelf
26' ¾" molding and 1" × 1" braces


LEFT - DETAIL OF DRAWER GLUE AND NAIL JOINTS RABBET BOTTOM INTO SIDES FRONT AND BACK
18"
BOTTOM
SHELF
SIDE
FRONT FACING
ABOVE - DETAIL OF SHELF RABBET LEFT - SHOWING FACING STRIP

Details for bookcase-secretary construction.



Pattern for curved parts of bookcase.

MATERIAL FOR BOOKCASE

1 19¼" × 60" back
5 9⅝" × 19¼" shelves
2 1" × 44" front
2 5" × 18" drawer
2 5" × 9⅝" drawer
1 [illegible]" × 17⅝" drawer
2 10" × 37" sides
1 53⅛" × 20" front
1 1" × 18" front
2 1" × 1" × 6" braces
2 1" × 1" × 12" braces
1 transfer design
1 drawer knob
Glue, nails, finish

All material ⅜" plywood, finished two sides, except as noted.

New Tools You Can Easily Make

(*Continued from page* 1104)

easy dismantling of the whole tool for cleaning or replacement.

Of the many odd uses for a cheap, cast steel die holder purchasable in any "five and ten," two are shown here in Figure 4. At "a" is an adjustable, easily aligned shaft support for light, high speed transmission. Not only does it serve its purpose well, but it is decidedly good looking. Saw off one arm, and drill the die ring either for an oil cup or an adjusting screw as at "b." The remaining arm is set-screwed into a pulley which in turn is drilled for mounting wood screws. The bearing may be made either by pouring babbitt metal or by drilling and slotting a brass insert disc as at "b." The brass type, of course, is adjustable for wear.

The other device which may be constructed of a die holder is a center holder for the lathe, shown at "b" and "c". Sometimes it is necessary to machine a long rod or shaft end, but as is often the case with small lathes, a suitable scroll chuck or holding attachment is not available. The operation may be performed accurately and quickly by gripping one end of the work in a three jaw drill chuck irrespective of its accuracy, and passing the other end of the work through the center holder. The type shown at "b" requires that several plug inserts with standard diameter holes be made. Five or six from ⅛ to ½ inch will handle most work. The one at "c," however, while not so accurate, does not require the plugs.

Lathe-Grinding Attachment

One of the most useful lathe accessories is a slide rest grinding attachment of the type illustrated in Fig. 5.

The body and bearing yoke is cut from ¼ inch mild steel or wrought iron by sawing, or drilling a series of holes and chiseling out and filing. It is then drilled to hold oil cups and the brass split bearings as at B in Fig. 6.

Drill rod ¼ inch in diameter is best suited for the shaft, one end of which is tapped for a long right hand 6-32 screw and the other for a left hand 6-32 screw. For outside grinding, the stone is mounted on the left hand screw and the hand feed knob rotates around the right hand screw. For grinding holes true, the pulley and stop collars are loosened and the shaft is remounted with the right hand screw holding the stone and the rotation of the shaft reversed. Neither of the hand feed knobs as in A and C of Fig. 6 are rigidly fixed to the shaft; they do not rotate when held by the fingers.

In A of Fig. 6, the screw head bears against a steel tube which in turn, bears against the shaft end. It is around this tube, that the knob, with suitable retaining washers and brass bushed hole, rotates. In C of Fig. 6, however, the brass bushed bakelite knob is permanently fixed loosely to a steel collar which may be set-screwed to either end of the shaft.

Win $3700.00!
Twenty-eight people, from a boy of 15 to elderly men and women, recently solved our puzzles and won a place in our Good Will Fund Prize Distribution. They won a total of $34,210.00.
We have deposited over $7,900.00 more in a large Chicago bank to pay dozens of new bigger prizes. Here's the qualifying test for this new opportunity. All prizes to be awarded in accordance with contestants' standings when final decision is made.
FIND THE TWINS
Here are 12 pictures of Clara Bow, the great Paramount Movie Star. Look at these pictures carefully. At first they all look alike—but that's the "catch"—so study them closely—do not make a mistake. Somewhere among these pictures are two, and only two, exactly alike—identical in hairdress, collars, and cuffs. They are the twin pictures of Clara Bow. If you are lucky enough to find them, by all means rush the numbers of the twins to me for submission to puzzle judges.
Additional $850.00 For Promptness
If your answer is correct, you will be eligible for this new prize distribution and may win the highest prize—a brand new 90 h. p. Waco airplane (and complete flying instruction) or $2850.00 cash with $850.00 extra for promptness, making the total $3,700.00 all cash. Many other prizes paid at same time. Duplicate prizes awarded in case of ties. Cash reward for all taking active part. No prize less than $10.00. No more puzzles for you to solve. No obligation. Perhaps YOU may be the winner of the highest prize! Send no money, but hurry! M. J. MATHER, Advertising Manager, Room 352, 54 West Illinois Street, Chicago, Ill.
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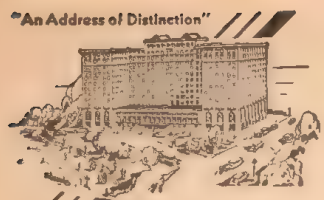

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Science and Invention's Message to Educators

RELATIVELY speaking, but few of our readers are engaged in the business of teaching the youth of our generation. But such is our interest in all sections of our readers that we are devoting this space this month to placing before school teachers the following suggestion.

Why not use the material contained in SCIENCE AND INVENTION each month as collateral reading for your students? Why not get your students to carry out some of the experiments we describe every month? Or, if you are interested in manual training, there is such a wide variety of how-to-make-it articles that you will almost certainly find something suitable for one of your classes to work on.

Let us glance through this issue.

"Canned Sunshine for Live Stock." This article gives an excellent lead for a brief interpretation of Ultra-Violet rays, what they are, where situated in the spectrum, how obtained, and their beneficial and injurious effects. If desired, more time could be spent on this subject and the students asked to write an essay on it.

The following articles, in addition to making interesting reading, contain much valuable scientific information of a general interest character: "When the Earth Quakes," "When Scientists Blow Soap Bubbles," "Weighing the Earth," "Penetrating the Atom with Beta and Gamma Rays."

For physical culture instructors the article entitled "Strong Man Tricks Which You Can Do" should have a particular appeal; it will certainly appeal to your male students. The physics instructor will find this an interesting demonstration of the applications of forces and levers.

In the realm of chemistry and physics, "Sunlight Forms New Molecules," is of particular interest.

Manual training instructors, both wood and metal, will find valuable material in the following articles: "Flying Taught by Mechanical Instructor" (complete constructional details of the machine) "Let an Indian Tepee Light Your Room," (a simple wood and fabric construction job), "Try These in Your Own Home Workshop" (useful tips for advanced students), "New Tools You Can Easily Make" (also for the advanced student), "Bookcases in the Modern Mode" (a simple wood working job), "For the Home Machinist" (another useful page for advanced students), "How You Can Photograph the Stars" (a simple construction job with a moral—it arouses a new interest in astronomy). "A Jig Saw for Your Workshop" (like some of the other advanced jobs, you might seriously consider this as a means of adding to your school equipment).

Every month there is something new, and we suggest that it will be well worth your while to study the pages of SCIENCE AND INVENTION with a view to making use of some of its contents. If we can help you any further in any way, we're here to serve you to the best of our ability.—*Editor,* SCIENCE AND INVENTION.

Magic

(*Continued from page* 1105)

apparatus. This is concealed beforehand in the magician's shoe, which should be loose fitting, and it is held in place directly beneath the heel. After a little practice the wizard will find no difficulty in walking about with the cricket in his shoe. When seated around the table, he has but to gain sufficient foot ease, permitted by the loose fitting shoe, for him to operate the clicks, and produce the spirit knocks.

Ultra Coin Production

THE dexterous worker of mystic wonders can produce a half-dollar size silver piece from his finger tips, after his hands have been found to be unquestionably empty, and his arms have been bared to the elbows.

The coin is of mechanical construction, and is in reality a disk of springy steel. One side of the disk has been painted to represent a silver piece. The other side has been coated with flesh colored paint. Thus it may be concealed about the finger, as illustrated, after it has been bent to grasp the finger firmly. At a distance, it is invisible.

In the act of production, the coin, or disk, is held open, to produce the desired effect. The coin may be made to vanish by reversing the action.

The Safety Valve

(*Continued from page* 1114)

ground, there is no movement. With relation to the train, the velocity is 100 *miles an hour because both bullet and gun are being separated at that rate of speed.*

Newton's Laws of Motion give the reasons why a person can jump up in a car of a train and yet the train does not move away from the person. A person sitting in a train has a certain momentum imparted to him. Should the train suddenly stop, that momentum still imparted to the man will cause him to move forward at the same rate of speed which he originally possessed. For this same reason, an aviator cannot ascend above the surface of the earth and wait in the air until the earth turns around under him. Of course, the air is carried around the earth with the body as it turns, but the laws of motion are an important factor.—EDITOR.)

Improving

"SCIENCE AND INVENTION" is certainly improving steadily. There are so many helpful and interesting articles in the last couple I purchased I have not been able to get sufficient time to read them thoroughly, as they deserve.

Your subscribers realize the great efficiency of the members of your editorial staff and I trust that you receive due credit.

The majority of your readers appreciate your sincere efforts in placing on the market the most useful periodical, both for young people and those needing advanced information along various lines. The care taken in regard to difficult diagrams and details is remarkable. A. WELLS, Alhambra, Calif.

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28x4.75-19"		2.45	1.20	31x4	2.95	1.15
30x4.95-21"		2.90	1.35	32x4	2.95	1.15
30x5 00-20"		2.95	1.35	33x4	2.95	1.15
28x5 25-18"		2.95	1.35	34x4	3.50	1.15
30x5 25-20"		2.95	1.35	32x4½	3.20	1.45
31x5 25-21"		3.20	1.35	33x4½	3.20	1.45
31x5.77-20"		3.20	1.40	34x4½	3.45	1.45
31x6.00-19"		3.20	1.40	30x5	3.60	1.75
32x6 00-20"		3.20	1.40	33x5	3.60	1.75
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ACROSS THE VOID, by Leslie F. Stone. (A serial in 3 parts) Part I. Once more this author comes forward with a tale of rare value in the field of scientific fiction. Many months ago, in her story, "Out of the Void," we got startling news from a distant planet, of which we of the earth had known nothing. Now, in this new, novel-length serial, we get the thrilling sequel, telling of the extraordinary adventures of the earth people, who had gone with the strange visitor from Abrul, to his planet.

THE AMBIDEXTER, by David H. Keller, M.D. Obviously, even eminent surgeons of international fame are not immune to the tendency toward revenge How another famous surgeon, in his supreme hour of need, trusts himself implicitly to this world-known colleague, and with what subtly drastic results, is exquisitely told in this extraordinary short story.

THE LAUGHING DEATH, by Stephen G. Hale. If an atom contains an almost limitless amount of energy, which, under the proper control, would yield enormous constructive power, what devastating destruction could such atomic energy, uncontrolled, exercise! Mr. Hale shows definite individuality of style in his writing, and he is, in our humble opinion, a real find for AMAZING STORIES.

TOO MANY BOARDS, by Harl Vincent shows how systematically things are arranged for our further misery—all done for our apparent good.

THE MENACE FROM ANDROMEDA, by Nat Schachner and Arthur L. Zagat. The title and the names following speak for themselves.

And other scientific fiction.

A Raft of Bucking Logs is Their Ocean Liner

(*Continued from page* 1075)

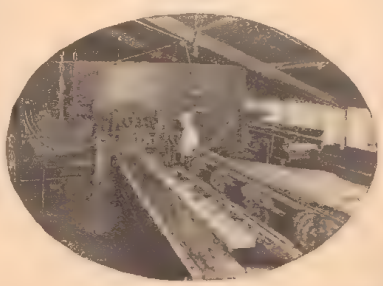
board, either, with the broad paddles of the "Nancy Gray" of Natchez fanning freely at your elbow, and your craft transforming itself into thousands of loosely plunging logs. Lots of people died of it.

Any fixed obstacle that would swing a raft broadside to the current gave a shining opportunity for a smash-up. However, unless the current was inordinately swift and the stream too narrow for a full swing, the crew stood an even chance of saving their timber. Hitting a towhead head-on was almost too much for a raft to survive. As a unit, that is. Eventually it might be re-fabricated. A towhead is a low alluvial island or shoal in a river.

The life of a raftsman has its compensations, though, just as it has its back-breaking work and its peculiar and hair-raising dangers. Raftsmen have never been notably downhearted. Quite the opposite, in fact. In good humor and merriment they average high. Romance clings to the raft—roistering romance—whether it floats on the Vah, the Volga, the Rhine, or on one of our American rivers. . . .

In the past tense, of course. The genuine hundred-per-cent. man-power style of timber rafting began to disappear from American inland waters as long ago as 1863. That was when the steam packet "Union" made its first rafting trip down the Upper Mississippi, pushing a floating cargo of pine. Three years later the steamboat "LeClaire" made the trip with a raft in tow.

What a road to adventure was the river in the 40's or 50's! Men and boys whose families had not glimpsed a town worth the name since before the Revolution, got taken on in a rafting crew and worked their way through a thousand marvelous scenes to Pittsburgh, St. Louis, or New Orleans. Then, with money in their pockets and presents for the folks, they returned in style, on a packet, drinking bonded



The sawyer stands at the right of the six-foot horizontal slab resaw, controlling the feeding devices which carry the slabs against the saw.

Bourbon with the best of them at the bar. Timber rafting at one time or another engaged some of America's finest figures. Abraham Lincoln, for one. For another, Walt Whitman.

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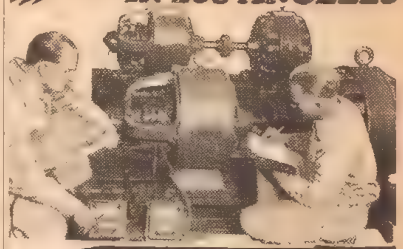

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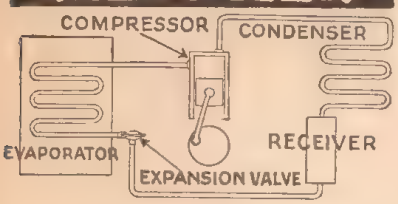

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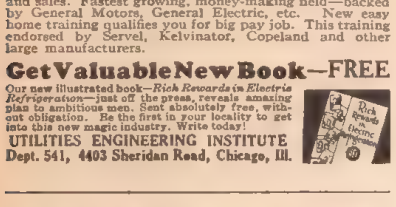

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In the man-power era, rafts were floated down to the Mississippi in sections, and fabricated when they reached the wider stream. In some tributaries, at high water, they could be floated as from the start. An average raft was made up of four to six "strings" of timber, each sixteen feet in width, laid side by side and fastened together by poles extending crosswise and held to the logs by hickory or elm straps and wooden plugs. Across each end of a string was hung an oar or sweep held in place by two-inch oaken pins. With these rude implements the crew kept the craft straight in the stream and away from the path of steamboats or proximity to sand bars or shoals.

Four hundred feet was no unusual length for an American timber raft of the man-power type. A crew of twenty to thirty men was needed to man such a craft, particularly because of the man-killing character of labor at the sweeps, of which there were from eight to a dozen. A typical sweep was built of a tamarack pole twenty feet long and twelve inches thick at the big or inner end. Into this was pinned a pine blade twelve feet in length, fourteen inches wide, and something more than two inches thick, tapering toward the outer end.

Later rafts, fabricated for steam tow, ran up to six hundred feet in length.

Steam-towed rafts of gigantic size have been effectively utilized of late years for timber transport along the American coast. Logs made in the Pacific Northwest are chained together in cigar-form rafts and towed down the coast to San Diego, California. The first cigar-shaped ocean-going raft was built in 1884, and was lost when its towing ship put in for coal on the way from Nova Scotia to New York. Later it was washed up in sections on the coast of Norway. The modern cigar-form raft is constructed in a cradle 700 feet long, moored in deep water. The logs are placed in the cradle by a power hoist. When complete, the raft is thirty to thirty-five feet deep at the center and from fifty to sixty feet wide, and contains from four to five million feet of timber. Cables are employed to bind it until its structure is complete, when it is enveloped by a network of 1.75-inch iron chain, about 115 tons in total weight. Then one side of the cradle is removed and the huge craft launched sidewise into the water.

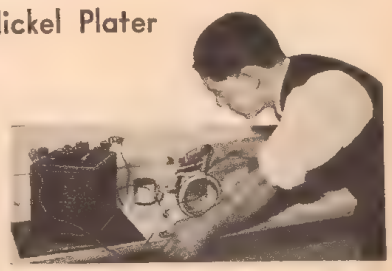
Sawmills range from the very simple to the very complex. In a well-equipped mill, the logs are handled mechanically from the hot pond to the finished lumber. A "bull chain" with projecting fingers carries them into the mill, and on the way in they are swept by streams of water which remove the last traces of dirt and grit, leaving them completely clean for sawing. The soaking they have received in the pond makes them cut more easily and dry more efficiently than if they were put through the mill immediately on arriving.

The sawyer first places the log on a carriage by means of a steam "kicker," and then signals the crew regarding the way the log must be set for cutting. Gauges conveniently arranged assist the setting operation. Heavy clamps hold the log in place, and the carriage presses it against the saw repeatedly, until the whole is in the form of planks.

In the course of the replacement of human strength and agility by power-operated devices, the lumberjack of the old carefree type has been pretty well squeezed out of the American woods. And with him, to an increased extent, are going the once-accepted hardships of the lumberman's life. Where once the bunk house with its unfriendly chill, its rank smell of drying clothing, and its hardboiled cooties was universal in the woods, living quarters with electric light and plumbing, strictly hygienic steel bunks and sanitary regulations, are now not unknown.

Clothing is dried in a room lined with steam pipes, and there is a shower room next door. The mess hall is shining white. The old metal dishes and cups have been replaced by crockery. Radio and even a large bookcase have places in a recreation hall. A community equipped in more modern fashion than many a village is erected for the logging crew in the deep woods. By no means is this uniform practice, but it is at least apparent in spots.

Be Your Own Nickel Plater



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We regret that we inadvertently failed to credit the photograph of the Freshfield Glacier on page 990, March issue, to the Smithsonian Institute, Washington, D.C.

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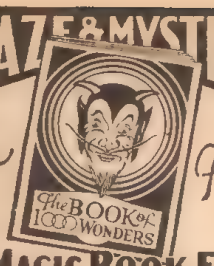

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For the Home Machinist

(*Continued from page* 1110)

job with cast surfaces; their points should be hardened and then the temper slightly drawn to avoid breakage.

Tool heads of the type shown in Figure 4 are generally used for rapid reduction in diameter of a bar stock. They are not necessarily accurate to the finest dimensions. For example, a shaft must be reduced at its end for a gear or pulley.

The hollow tool head can be made to accommodate three cutters and supplement the tool post. The head is secured in the lathe tail stock by a tapered shank. A quick roughing cut is taken on the stock. It requires no support behind the work, as would a tool in the post making a heavy cut. The body of the head is usually of cast iron, though steel or bronze can also be used. The short stub cutters are held in with screws. For rapid work, one of these heads will prove well worth adding to the lathe equipment.

In lathe boring, a deep cutting job requires the use of a long tool. It is possible (as in the upper view of Figure 5) to use any solid bar mounted in the tool post. With a tool steel cutter secured to the bar with a screw, only a small piece of tool steel is required in the cutter. This part is renewable at small expense. For recessed cuts an adjustable box holder (as in the second view) has many advantages. One screw, if loosened, allows the tool to swing out and clear when entering the work. As cutting proceeds, the tool is adjusted by the screws.

The solid type of boring tool (illustrated in the lower view) is generally used in the lathe. Obviously the same grade of steel is required throughout, making it an expensive item and serviceable only in small cutters for boring small holes of limited depth.

The Oracle

(*Continued from page* 1116)

takes the moon to make its revolution from a given star to the same star again, as seen from the center of the earth. It averages 27 days, 43 minutes, 11.47 seconds, but it varies some seven hours on account of perturbation. (Change in path of orbit due to approach of some other heavenly body). The mean, daily variation is 360 degrees divided by 27.32166, or 13 degrees, 11 seconds. Mechanically considered the sidereal is the true month.

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Overhauling Your Outboard Motor

(*Continued from page* 1088)

own tension, then gently remove the metal strips from under the rings and they will slip right into the grooves without further effort and save you much hard labor! Now clean out all carbon residue and you are ready to check connecting rods and bearings.

Check connecting rods for end play as follows: Holding the piston in one hand and the crank case in the other, pull toward you on the piston in short jerks If there is any appreciable movement remove the lower end of the rod by taking out two screws. Then lay the lower half of the bearing face down on a smooth flat file and gently move the bearing back and forth over the file, exerting just enough pressure to make the file grip the metal so as to feel a drag on the bearing. Great care must be taken to keep the bearing perfectly flat on the file and by all means DO NOT REMOVE MORE THAN FROM 2 to 4 one-thousands of an inch of metal from the face of the bearing. This means half a dozen pulls each way on the file! A more efficient method would be to remove the crank shaft and work from both faces of the bearing, but as this requires mechanical skill of the first degree it is not to be recommended to a novice.

After replacing the connecting rods, stand the crank case so that the piston is leaning against the case wall. Now, with the index finger, gently push the piston toward the opposite side of the crank case, and, as it passes the center or directly upright position, notice if it falls over without aid from your finger. If it does, the bearing is right. However, should the piston require pressure from you, in order to make it touch the other side of the case, it is too tight and the bottom of the bearing should be tapped with the ball head of your hammer until the piston falls of its own accord and rocks freely.

In replacing pistons be sure the high

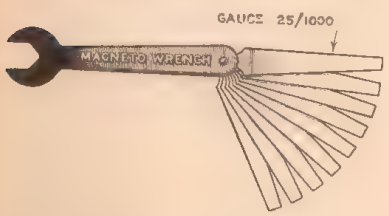

Fig. 1—Use this blade to determine necessary clearance between breaker points. See text.

side of the top of the piston is toward the top of the crank shaft and make sure that the key in the shaft is directly opposite and pointing toward the arrow head on top of the crank case (Fig. 3)

To test the gears in the lower housing, place the housing across your knees with fin pointing to your left, and in an upright position with drive shaft at the top. Hold the drive shaft in one hand and take the propellor shaft in the other, leaving the shear pin in place to help in turning the shaft. Now rock the propellor shaft gently from left to right, slowly turning the drive shaft with the other hand at the same time. If there is binding at any point all round the shaft, then the thrust bearing must be loosened, which can be done by unscrewing the large screw at the end of the housing opposite the propellor end.

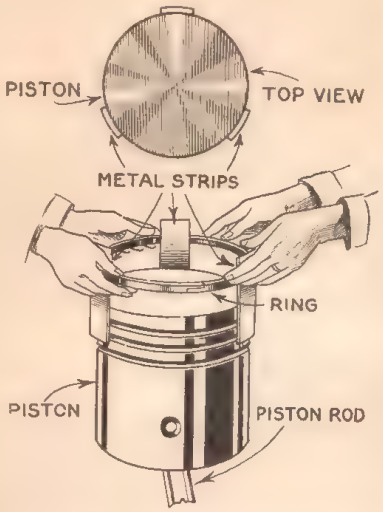

Fig. 2—Install new piston rings this way.

If there is an abundance of play, and a loud "click" when the drive shaft is turned against the propellor shaft, then the gears mesh too lightly and the screw must be tightened until the "click" is barely audible. Don't mesh the gears too tightly and don't fail to lock the nuts over the lock washers when replacing the gear housing.

In putting the motor together again it is a good plan to take all pipe elbows off and examine them for corrosion, as the force of the water coming through the line will frequently deposit a small amount of grit or dirt in the elbows and in time, unless removed, this will clog the entire water system and burn out your motor.

Every once in a while you will hear an outboard fan say that his motor has suddenly dropped a lot of revolutions and lost much power, although it has just come from an overhauling and should be quite the reverse. Here is what I discovered in mine.

Due to the use of large amounts of oil, the muffler holes in either end had become carbonized and stopped up. Therefore, as each explosion occurred, instead of the foul gases being expelled into the air, they were being held and compressed in the muffler, creating a powerful back pressure that would not allow the gases to fully escape from the combustion chamber, contaminating each new charge as it arrived, cutting the force of the explosion, slowing the action and of course killing the power to a marked degree.

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an inch. The gauge on your magneto wrench is just right for measuring this. Be sure and refill the gear case with the proper grease, make sure that all elbows, joints, nuts, bolts and screws are tight, and with these things accomplished your motor will be in tip-top shape and ready for any test. Here's how to make the compression testing gauge a mighty valuable accessory, I can assure you!

This compression tester should cost about three dollars to build and will save you many a headache—

First get a tire gauge with a glassed dial face; then take the threaded base off of a Champion Metric Plug and solder this threaded sleeve on to the tire gauge. Then every week or two just take one sparkplug out of your motor, screw this compression tester in, pull your motor over and make a note of the pound pressure. It is best to make three pulls to get an average and just take a slow, easy, firm pull. Then repeat the operation on the other side and you can then compare the pressures. The main thing is to see that the compression is even. If there is a considerable difference of say twenty pounds you have a cracked ring and you should put in another. If the difference is only five to ten pounds your ring is sloppy and badly worn and a new one should be put in. It will give you a great deal of satisfaction to know that both cylinders are doing an equal amount of work and your motor will last longer and go faster, but when you take out or put in rings be sure that you don't scratch or mar the piston ring groove. It is necessary to be very careful in doing this and to soak the carbon off with gasoline.

When you first get your motor together and it's still somewhat stiff, put it on your boat, tie the boat to the dock, then run your motor for a minute or two as fast at she'll take it until she's good and hot. Then shut it off quickly, remove the plugs with the monkey wrench, and while you turn the motor over by taking hold of the magneto, squeeze two or three inches of vaseline out of a tube of ordinary drugstore vaseline into the plug holes of each cylinder. This will spread all over the cylinder walls and sides of the pistons as the motor is turned over. Then start your motor and run for a few seconds. Do the same thing all over again several times. This vaseline under heat will put a hard smooth coating over the cylinder walls, a glazed finish which is hard to get in any other way, and you will have less trouble from broken rings and poor lubrication, and certainly you will have more revolutions and hence more power in the motor.

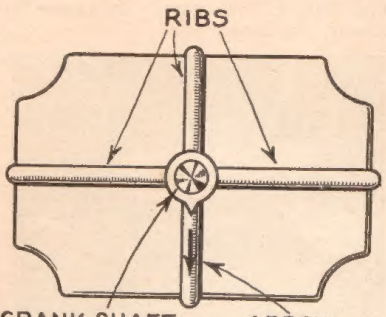

Fig. 3—Top view of the crank case.

This same theory of glazed cylinder walls has caused the famous "believe it or not" of outboard racing, in that many outboard racing motors after they have been tipped over will turn up more revolutions than before the accident. This of course is providing the rods have not been sprung or otherwise damaged, and actually this seems to be so, because the motor is very hot at the moment of submerging and the cold water striking the hot steel walls crystallizes the surface and makes them much harder than before.

Taking Care of Your Car

(*Continued from page* 1108)

mize. A study of the sketch will show the simple parts of this tool: two bolts, with nuts, and three pieces of bent strip steel. The sizes are unimportant, except that the bolts should be about ¾ inch and the steel heavier than ⅜ inch. The bending is best done while the metal is hot.

New models of cars sport radiator screens. It may be interesting to owners to know that these can be made from strips of aluminum and galvanized iron meshed wire. The details are shown in the attached sketch, depicting a screen made up by the owner of a light car.

Strips of aluminum were used for the binding; brass can also be used. The screen wire was cut to the shape of the radiator and the frame was fashioned similarly. A grommet was made for the starting crank as shown. Small clip fasteners were used to attach this to the radiator shell. Aluminum paint completed the job.

The formation of frost and sleet on the windshield is not easily prevented. The interference with driver's view and safety is an important feature, justifying preventive means, as illustrated.

A celluloid shield inside the glass, made by shaping a piece of celluloid into a shallow cover, is useful. It both prevents frost from forming on the inside of the glass and tends to keep the outside clear. Cement the celluloid parts with acetone varnish and use tape around the edges.

A draft of warm air from under the hood is also effective. It is obtainable by placing wads of cotton between the ledge and the hood. The warm air keeps sleet from forming.

A third means is wiping the glass with a cloth saturated with a solution of glycerine, water and salt.

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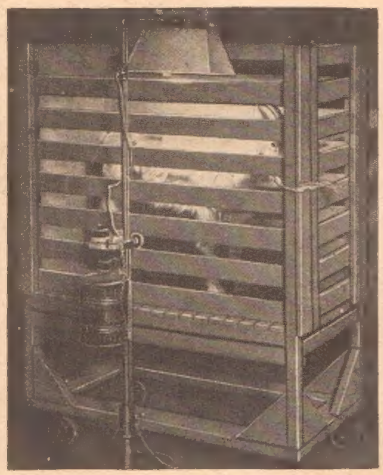
Canned Sunshine for Live Stock

(*Continued from page* 1069)

be in the absence of these rays. Furthermore, whatever calcium may have already been assimilated and built into the animal body cannot even be retained in the absence of these radiations. In this manner, light comes to act in a very important capacity, for we are realizing more and more every day the important function which calcium performs in the animal body. Calcium provides bone rigidity and functions in connection with the irritability of muscle and nerves. Unfortunately calcium is not abundant in most foods used by man and beast. Therefore, it is necessary that the available supply be used efficiently and conserved."



Irradiating milch goats to increase the vitamin-D content of their milk.

After activating animal tissues with ultra-violet light from a quartz mercury-vapor lamp, Dr. Steenbock tested fresh plant and animal oils of various kinds to determine if they could be activated similarly. The results were successful with lard, butter, fat, olive, cocoanut, cottonseed and corn oil. Cod liver oil used extensively in poultry feeding during the winter months, when bright sunny days are rare, gains its activity and content of vitamin-D from the fact that ultra-violet rays penetrate water with ease. So solar radiation is responsible for the activation of the oil recovered upon a commercial scale from the codfish.

Dr. Steenbock exposed such food products as wheat flour, rolled oats, cornmeal and hominy to irradiation and then fed these activated materials to experimental rats suffering from rickets. In the course of several weeks, the ricket-afflicted rats were restored to good health on irradiated foods which were rich in vitamin-D. Leg weakness in chicks, which formerly collected rich tribute annually from American poultry industry, proved to be nothing more than rickets, cured by treatment with cod liver oil or by exposure to ultra-violet rays.

Irradiation increases the hatchability of eggs. Under average commercial conditions only about three-tenths of the setting egg supplies hatch out into healthy chicks. Baby chicks by the billion are probably killed by rickets before they gain enough strength to break the shells which encircle them. During a one month period, a group of 12 irradiated hens at the Wisconsin Agricultural College laid 173 eggs, while a similar lot of non-irradiated hens produced only 68 eggs. The irradiated hen eggs hatched out 168 healthy chicks when incubated, while only 22 eggs from the untreated hens were hatched successfully.

Rickets, which are extremely prevalent in the north temperate zone, is very rare in tropical countries because in the latter latitude the skin of both men and animals is exposed to daily irradiation by the sun's rays. This exposure activates vitamin-D and favors calcium assimilation.

Milk was also submitted to several tests. It is now possible to irradiate milk, thus increasing calcium deposition in the children who consume that milk. The Badger State specialists have even gone so far as to increase the antrichitic properties of cow's milk as much as 800 per cent simply by exposing that liquid food under a quartz mercury-vapor lamp for 30 minutes, at a distance of two feet. Goat's milk was increased 2400 per cent in antirachitic properties by similar treatment. This increase can also be induced rather promptly, but to a less degree, by the direct irradiation of the animal that produces the milk. If dairymen will potentially irradiate milk on a commercial scale, mankind in general will benefit greatly from such practices.

Scientific Aids to Your Comfort

(*Continued from page* 1106)

your ashes into the cup, saucer or plate before you? This coaster ash tray will both give you a place for your ashes and save the linen from being soiled by water, iced tea, and other beverages. It is pretty enough to use at bridge parties, and can be obtained in either crystal or a pink rose. Tested and approved in our laboratory.

This coaster ash tray is both serviceable and decorative.

Pat 1562

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Is this sentence correct? *He doesn't feel good.*
Who was Homer?
By what rule of economics does Charlie Chaplin earn more money than ex-President Coolidge?
Who said, "Give me liberty or give me death"?
Which freezes quickest—water, mercury, alcohol?
Do fish sleep?
What is a pentameter?
Who wrote *Virginibus Puerisque*?
What nation first divided time into months, weeks, hours, minutes and seconds?
Where was the Pantheon?
Why is glass transparent?

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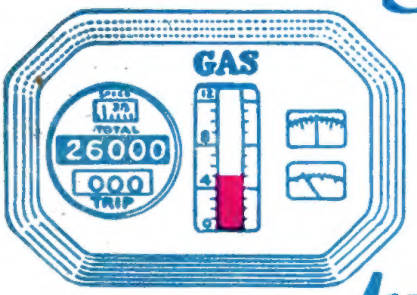
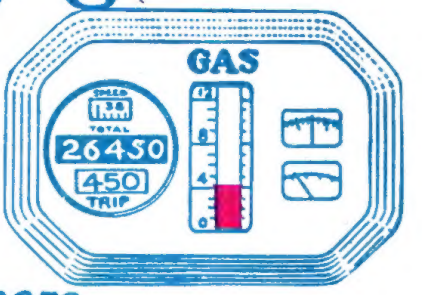
on a gallon of gas



startling statement of famous Automotive Engineers



How to increase gasoline mileage has been a problem that Automotive Engineers have been trying for years to solve. Recently a world famous engineer made the statement that the energy produced by burning a gallon of gasoline would run an auto a distance of 450 miles. Other well known authorities go on record as saying that eventually it may be possible to get over four times as much out of gasoline as in the past.

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Mark H. Estes writes: "I was making 17 miles to the gallon on my Pontiac Coupe. Today, with the Whirlwind, I am making 35 5/10 miles to the gallon. Am I glad I put it on? I'll say so!"

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R. J. Tulp: "The Whirlwind increased the mileage on our Ford truck from 12 to 26 miles to the gallon and 25 per cent in speed. We placed another on a Willys-Knight and increased from 12 to 17 miles per gallon."

Arthur Grant: "I have an Oakland touring car that has been giving me 15 miles to the gallon average, but I can see a great difference with the Whirlwind, as it climbs the big hills on high and gives me better than 23 miles to the gallon of gas, which is better than 50 per cent saving in gas."

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